# Marine Engineering

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H. H. BROWN, Managing Editor
S. M. PHILLIPS, Associate Editor L. S. BLODGETT, Associate Editor
W. Z. GARDNER, News Editor

*Contributing Editors*

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## Shipping Board Makes Grave Mistake

AS MARINE ENGINEERING goes to press the daily newspapers contain columns about the seizure by the United States Shipping Board Emergency Fleet Corporation of a number of boats turned over to the United States Mail Steamship Company to operate, including the *America,* scheduled to sail July 26, and the *George Washington,* due to leave for the other side on August 3.

The reason given by the United States Shipping Board for the seizure is that the United States Mail Steamship Company has failed to pay some $400,000 due for rentals of the boats. The counter contention by the steamship company is that it actually owes nothing, inasmuch as it has a just counter claim against the United States Shipping Board for a large sum of money paid out for reconditioning steamers for the account of the United States Shipping Board. The United States Mail Steamship Company further contends that the seizure was illegal in view of a certain contract between the company and the Shipping Board, which provides that disputes should be subjected to arbitration.

In view of the counter contentions and the probability that the whole matter will be thrown into the courts for adjudication, any discussion of the points involved would be out of order at this time. However, irrespective of the legality of the seizure or the justice or injustice to the United States Mail Steamship Company involved therein, the proceeding as carried out certainly reflects discredit on those responsible. Instead of an orderly procedure such as is common in the regular conduct of every established business, the United States Shipping Board went forth as a crusader with a blare of trumpets, a bevy of newspaper reporters and, we presume, the customary camera contingent, which resulted in long, front page articles with scareheads in a number of daily newspapers throughout the country—this at a time when substantially everyone concerned had his shoulder to the wheel trying to help the United States Shipping Board in its announced intention of putting and keeping the American flag on the high seas. At best there can be no real American Merchant Marine without hard fighting at every step. The deliberate and profuse publicity, which at least could easily have been obviated, cannot but tend to discourage the public from patronizing ships which fly the American flag and cause our attempt to compete with foreign ships to appear increasingly ludicrous in the eyes of people on the other side of the water. In view of the excellent progress made by the new Shipping Board in matters of reorganization and selection of experienced key men it is most unfortunate for the welfare of American shipping to have an action of this sort take place in the manner in which it did.

## Port Facilities

ALTHOUGH shipping along with other industries is passing through a time of depression, it is most significant to note that large sums of money are being spent all over the country for improving harbors and expanding cargo handling facilities. This is encouraging not only because it will prevent a repetition of former times of embarrassing congestion and consequent loss of time and money, but because it shows so conclusively that the country has sufficient faith in the future of the shipping industry to spend large sums in preparation for the return of normal trade.

While the Port of New York for many reasons, both financial and geographical, handles at present about 50 percent of the export and import business of the country, the future development of our commerce will undoubtedly include all the American ports which are advantageously situated. Congress evidently had this in mind when it stipulated that the members of the Shipping Board should be chosen from specific geographical locations. Mr. Lasker, the chairman, also has this point of view for he recently stated that it was the purpose of the Board to act in partnership with all the ports, as well as with New York, to aid the development of American shipping.

But what is more significant, let us consider briefly a few important typical American ports. Seattle is rapidly increasing her port facilities, including an industrial canal connecting Lake Washington and Lake Union with Puget Sound, both lakes being large fresh water bodies well suited for extensive industrial development. San Francisco has almost unlimited natural facilities for expansion. Los Angeles recently voted a bond issue of $4,800,000 for all kinds of harbor development. Houston and Galveston are increasing their port facilities so fast that it is a question now if this district does not rank second as an exporting center. New Orleans, with its recently constructed deep water canal, has largely increased a waterfront already extensive. This canal makes a new outlet to the northeast, making it



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possible to avoid the Mississippi Delta on northern routes. Baltimore is expending vast sums of money on harbor improvements, including a wide marginal way and modern terminals; and New York and Philadelphia have, as is well known, expended enormous efforts in developing war facilities.

And so we might go on naming individual projects where real money is being spent on the assumption that the total cost of transportation—rail and water—from interior points to foreign countries, will be the principal factor which will influence the movement of tonnage in the future. For the merchant marine these port developments are worth more than reams of paper arguments that business and capital have faith in the future of American shipping.

## Support American Shipping

EVIDENCE that the interior sections of the country are still interested in the development of the American merchant marine was received recently by Chairman Lasker in a letter from the president of the Millers' National Federation. This organization at the Chicago convention unanimously reaffirmed the pledge it gave Admiral Benson several months ago to support our merchant marine and the Shipping Board. This is an important decision because the milling industry is the third largest exporter in point of bulk in this country and it can do a great deal in the way of providing tonnage for American bottoms.

Another organization, the Mississippi Valley Association, whose membership is composed of progressive business men from the twenty-seven states adjacent to the Mississippi and its tributaries, has recorded its resolution to support the merchant marine. The value of the support of this organization is two-fold, both practical and political; for it not only means the good will of business interests, but the representatives of these twenty-seven states which have a majority in both houses of Congress are bound to give consideration to the association's requests and suggestions.

In this connection the Mississippi Valley Association has passed a resolution favoring the full enforcement of the Merchant Marine Act of 1920, which would mean that shipping would get the same kind of support and protection that manufacturing and agriculture now have. It is very hard to see why any foreign country could object to a small preferential shipping duty to equalize the cost of the operation of vessels under the American flag and at the same time accept without the strongest protest the high custom duties which we are placing and propose to place on their products.

## Vessels for Lighthouse Service

IN an editorial in the May issue of MARINE ENGINEERING we carefully explained the pressing necessity for new vessels for the Lighthouse Service. With twenty lightships over thirty years old and seventeen lighthouse tenders over twenty-five years old, and with one of these ships having reached the antique age of sixty-five years, it is evident that this important Bureau is performing its hazardous duties as a most important aid to navigation under very serious conditions.

In the latter part of June the Bath Iron Works, Ltd., was awarded a contract to build five lightships at a total cost of $920,000, a sum which last summer would have been sufficient to purchase only two and certainly not more than three of these ships. The next highest bidder, the Sun Shipbuilding Company, offered to build these five lightships for $975,000, which shows that reliable shipyards today are willing to accept contracts on a very small margin of profit—if any profit is possible at these figures—and at a price which the Government cannot hope to duplicate in the future.

The Lighthouse Service is a very efficient and deserving bureau. In addition to maintaining a vast number of lighthouses, lightships, buoys, fog horns and other aids to navigation, it is progressive and at present is doing some very good work with the radio compass, which is described on page 620 of this magazine.

Congress will appropriate for the coming year over three and a half billions of dollars. Would it not be good business economy from every standpoint to give this bureau a sum equal to less than one-thousandth of this appropriation for the additional vessels that it needs and which it should have had four or five years ago? It is nothing less than criminal negligence to permit these old ships to navigate in dangerous shoals which all other vessels evade. It is poor economy to keep them in commission because the repair bills are excessive and it is foolish to risk the wrecking of a liner costing several million dollars, to say nothing of the loss of lives, for a few $200,000 ships.

## Superheated Steam

IN our present attempt to place American shipping permanently on the sea every means looking toward economy should receive proper consideration, and among them a prominent position can be accorded to the use of superheated steam. This is particularly true because European shipowners have been using superheated steam successfully for several years and ample proof that they have found it a means of securing greater efficiency and economy is shown by the fact that all the new Cunard liners are to be equipped with high degree superheaters.

In connection with the turbines installed in the new Cunard liners, it may be stated that this type of machinery is now well established for marine propulsion and there is no essential reason why it may not realize at sea the high degree of economy already common in land power stations. Steam turbines can realize the advantages of sufficient expansion and of a good vacuum; and steam turbine engineers, especially the English, are keen for superheating and claim that in practice they realize more than is promised by the theory of thermodynamics. While the average engineer is generally more impressed with results than theory, still at the same time this gain may be theoretically accounted for as a reduction in steam friction on the turbine blades.

A good marine engineer is a very important factor in the economical operation of a ship. He can do wonders with both the fuel and repair bills and in these days of fierce competition it is up to progressive shipowners and operators to give him every mechanical means of getting the maximum amount of power out of every pound of fuel that the boilers consume.

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# Why Has the Merchant Marine Act Been Nullified?

## Failure to Enforce the Law Leaves American Overseas Shipping Absolutely Unprotected Against the Discriminations of Its Competitors

By Winthrop L. Marvin*

IT is now fourteen months since the Merchant Marine Act of 1920, the Jones law, was enacted and it is an ugly fact of undeniable significance that not one of the provisions intended by the authors of that measure to give positive protection and encouragement to American overseas shipping has been enforced. These provisions were deliberately ignored and nullified by President Wilson's Administration. I refer particularly to the provision of Section 23, that American owners of American ships be exempted from excess profits taxes on their ships operated in the foreign trade, if certain conditions are complied with; to Section 24, the requirement that all mails of the United States shipped or carried on vessels shall, if practicable, be shipped or carried on American-built vessels documented under the laws of the United States; to Section 34, directing the President within ninety days from the passage of the Act to give notice of the termination of treaties preventing the imposition of discriminating customs duties and tonnage dues on foreign vessels entering American ports; and to Section 28, reserving to American ships the carrying of those exports from and imports into this country which receive low preferential rates on American railroads.

There may be objections, there undoubtedly are objections in certain quarters, to the policy embodied in any or all of these provisions of the new Merchant Marine Law. It may be urged that any or all of them contravene the interests of our competitors in ocean trade. A considerable body of public opinion is undoubtedly averse to a revival of the early policy of discriminating customs duties and tonnage dues as a certain irritant to the governments of foreign countries.

But the hard fact remains that these provisions are the law of the land, enacted by a very great majority of Congress and duly approved by the Chief Executive. Every paragraph of the Merchant Marine Act of 1920 should have been honestly enforced in the spirit in which it was written, unless abandoned and repealed by the law-making authorities of the nation.

### Other Federal Laws Inflexibly Enforced

This enforcement is the course that is inflexibly pursued with regard to other federal laws, even such as happen to be questioned and opposed by some elements of our population. Why were not these sections of the law obeyed and enforced in the present case, particularly Section 34, so clearly directing the President of the United States, "within ninety days after this Act becomes law," to take steps to terminate such parts of our commercial treaties as forbade the application of discriminating customs duties and tonnage dues? I am not urging that this would be the wisest and best policy for our merchant marine, or that application of it would be without risk, but the outstanding fact is that the Senate and House, exercising their constitutional right, directed the President to do this and he deliberately refused to do it. Technically, President Wilson could undoubtedly have been impeached for his declination to honor the plain mandate of a law which he had signed and approved, even though foreign governments objected to it.

Mr. Wilson could have asked Congress to repeal the provision if it were distasteful to him or menacing to the public peace and welfare. But he did not do so; he simply refused to enforce this section of the law exactly as his Treasury Department refused to frame the regulations for the enforcement of, and thereby deliberately nullified for the time being, the provisions of Section 23, exempting American ships in the foreign trade from excess profits taxation.

When the Merchant Marine Law was passed by such a commanding vote by Congress in the early days of June, 1920, and President Wilson signed it, the Act was hailed as a great triumph for the new American merchant marine. As a matter of fact, all the outstanding features of that law, so far as positive action is concerned, have been left a dead letter on the statute books though every other law that that Congress passed has been honestly respected and enforced by the executive departments of the government.

A great many years ago one Thomas Jefferson said:

"If particular nations grasp an undue share of our commerce * * * defensive and protective measures become necessary on the part of the nation whose marine resources are thus invaded; or it will be disarmed of its defence, its productions will be at the mercy of the nation which has possessed itself exclusively of the means of carrying them and its politics may be influenced by those who command its commerce."

### Are Our Statesmen Afraid of Our Competitors?

Is it possible that our almost complete dependence upon foreign shipping in our country from 1865 to 1917 has given our competitors a subtle power so to influence American statesmen as to nullify American laws and that on this point America actually still remains in a state of Colonial servitude?

Unfolding of the policies of the new Administration must soon tell the story. Again I would emphasize that it makes no vital difference whether Section 34 relative to discriminating duties is a good provision of law or a bad provision. It is the law of the United States and President Harding must soon obey it or frankly ask for its cancellation. So, also, with the other positive provisions of the Merchant Marine Act which I have mentioned. They all must be either enforced or eliminated.

A great many of our public men and of our people believe that a carefully drawn subsidy policy, particularly based on the naval reserve, is wiser and more effective than a discriminating duty policy and would place our merchant marine on a more certain foundation. I do myself incline to that view. But it is essential that all those Americans who prefer another policy than discriminating duties, as well as those who advocate that expedient, should face the fact that any hostile influence in this country that can secure the nullification of one kind of shipping law once passed by Congress will also most certainly prevail to secure the nullification of another, unless a most emphatic protest is made by the shipowners and shipbuilders of this country and an aroused majority of the American people.

### Time for the American People to Protest

It is full time that such a protest were made in tones of thunder. The American merchant marine, in spite of the brilliant promise of the law of 1920, is steadily, month by month, losing its control of even a part of our own American commerce. It is an ominous fact that cannot be denied and

*Vice-President and General Manager, American Steamship Owners' Association.



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cannot be evaded. Official records of the government show that in April, 1921, only 37 percent of our imports was conveyed in American ships as against 41 percent in April, 1920, and that only 40 percent of our exports was conveyed in American ships as against 48 percent in April of 1920. Foreign vessels in April, 1921, carried 60 percent of our exports and 63 percent of our imports, or well nigh two-thirds of our international exchanges. Almost every month of the entire year has shown foreign shipowners strengthening their hold on the seaborne trade of the American people and a larger and larger proportion of American ships, government owned and privately owned, forced to quit the sea and to tie up at the docks or swing idly at anchor in our harbors. This process has continued until one-half of the Shipping Board steamers and more than one-fourth of privately owned American tonnage is now unemployed.

### American Overseas Shipping Absolutely Unprotected

It is not the mere depression of trade that has done this. If it were, American vessels, available in large numbers, would still be carrying the same percentage of this lessened commerce as a year ago. American ships are being driven off the ocean because American overseas shipping, in spite of the vigorous provisions of the Jones law, remains an absolutely unprotected industry; unprotected against the cheap wages and the bounties, subsidies and powerful commercial discriminations of foreign lands.

A few months ago an American concern that had a contract for the transatlantic shipment of a large quantity of Southern cotton from a Gulf port was told that the British consignees of this cotton refused to receive it in any other than British bottoms or to have it insured in any other than British underwriting companies. This American shipping concern, therefore, had no alternative but to turn its American vessels back to the Shipping Board and charter British steamers because the cotton spinners of Lancashire, true to that spirit that has helped to make the British mercantile marine the greatest in the world, insisted on employing none but British carriers.

Another American shipping company, months ago, offered to bring to this country at substantially lower freight rates a quantity of Egyptian cotton purchased by and for the great mills of New England. But these American shipowners were bluntly told that they could not get a pound of it, that their ships must return empty to the United States because the British merchants who handled the Egyptian cotton crop had an exclusive contract with the British steamship conference, which precluded the use of American ships.

### Aggressive Discrimination Against American Ships

These typical instances show one aggressive discrimination which American ships are up against in their efforts to secure for our country and its flag a fair share of the carrying of our country's commerce. But there are other and grave obstacles in the higher wage and living standards of the personnel of our merchant marine in this initial stage of its development. The payroll of officers and men of an American steamer of 9,000 tons deadweight is from $1,000 to $1,500 a month above the payroll of a British or Norwegian ship of like capacity. It is true, as is often asserted, that except our own, British steamers pay the highest wages in the world; substantially higher than the wages of Italians, Greeks, Spaniards or Japanese. But the old, firmly established British mercantile marine enjoys a compensation for its higher wage scale in the complete, intensive British commercial combination which girds the world, of which this Southern cotton case and the Egyptian cotton case just cited are examples. This great world-round British combination insistently prefers and works for the interests of British ships. There is not yet, nor is there soon likely to be, a similar American combination for American ships.

In view of these circumstances only one thing can possibly save our own merchant marine in the losing fight which it is waging, and that is the aggressive backing of American manufacturers and merchants and of the American government. It is no mere boy's play, no holiday rose-tossing, this maritime rivalry on which our ships have entered. It is a grim, dogged encounter in which our competitors cherish few scruples and show no grace. They will beat us if they can and destroy us on the ocean as they did in the merciless rivalry of the decade before and the half century after our Civil War. If rival governments are strong enough in the United States, by diplomatic protest or commercial and political influence, to prevent the enforcement of the most aggressive provisions of the Merchant Marine Act of 1920 as they manifestly were throughout the Wilson Administration, they will be strong enough, unless the American people are thoroughly aroused to action, to nullify similarly any further laws which the Harding Administration may receive from a Republican Congress.

No miracles will in themselves be worked by a mere change of political control in Washington. A great majority of the American people believe in the patriotism and courage of the present National Administration. They demonstrated this by preferring it to a continuance of the rather uncertain control under which the nation had lived for eight trying years. But this great popular majority must make up its mind to stand by President Harding and the commissioners of his new Shipping Board, and loyally hold up their hands, if this present heart-breaking decline of our new merchant marine is to be checked and another crushing national disaster be averted.

## Progress of Shipping Legislation

There has been little activity in Congress during the past month on legislation relating to shipping, as Congress is settling down to the special objects for which it was called in extraordinary session, namely, taxation and tariff legislation. Senator Cummins has introduced in the Senate a bill, S. 2203, to establish a government ship line between United States and Alaska to connect with the government railroad in that territory. The bill, S. 745, providing for workmen's compensation for maritime workers was passed by the Senate on June 10 and referred to the House committee on judiciary, which has not yet acted upon it. The Scott bill, H.R. 6754, to afford relief to passenger and package boats on the Great Lakes by modifying the requirements of the La Follette seamen's act as to working conditions for crews on vessels on the Great Lakes, has been passed by the House and referred to the Senate committee on commerce. The bill, H.R. 6775, to regulate marine insurance in the District of Columbia, was favorably reported without amendment from the House committee on the District of Columbia on June 21 and has been placed on the calendar of the House. Senator Borah's bill, S. 665, to allow coastwise shipping to use the Panama Canal without the payment of tolls, has been reported to the Senate but has not been acted upon.

The conference report on the Naval appropriation bill, carrying about $410,000,000, was adopted by both houses of Congress on July 11 and signed by the President on the following day.

The sub-committee on marine insurance of the House Committee on Merchant Marine and Fisheries has been directed by the committee to investigate the causes for substantial increases in the loss of shipments on vessels through pilferage, breakage and short cargoes, which have been reported to the committee. The object of the investigation will be to ascertain, if possible, methods for cutting down the losses. The sub-committee plans to hold hearings in the near future.

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# Reorganization of the Shipping Board

## Three Main Objectives, Disposition of Government Vessels, Operation of Government Vessels and Settlement of Claims

**By Waldon Fawcett**

ELOQUENT not so much of the evolution of new policies as of a new determination promptly to carry into effect administrative policies, long standing or foreordained, is the reorganization of the United States Shipping Board under the direction of Chairman Albert D. Lasker. Appointed to his new post on his reputation as an executive capable of quick accomplishment, the transplanted head of a great advertising agency had no sooner surveyed his new responsibilities than he gave warning that an impatient public must not expect instantaneous results. Although it might appear to the layman, looking on, that the entire time since the signing of the armistice has been occupied in official "investigations" of the Shipping Board and its operations, the new head of the institution may find justification for his claim that the new management must make careful survey of the situation that confronts it, ere it can act.

From the standpoint of the shipping and shipbuilding interests of the United States and of the world, curiosity as to the future course of the Shipping Board has three main objectives; that is to say, three lines of policy affecting practical maritime affairs are in the balance. With the interior organization of the Shipping Board, shipping men are but remotely or indirectly concerned. The problem of the reduction of the clerical force of the Board, regarding which official Washington has been so deeply exercised, and even the supposed scandals of maladministration, have relatively little significance for the men who construct and operate ships. The labor policy of the Shipping Board is of consequence, to be sure, because of its influence upon the labor situation in the private shipping field, but three fundamentals of Shipping Board policy must inevitably focus the attention of the maritime community.

### Three Main Objectives

The first of these is the policy to be pursued in the disposition of the surplus vessel property of the United States, acquired during the war emergency. The second is the policy that is to obtain in the operation of the ships that are to continue permanently or indefinitely under government ownership or control. Third is the policy that will prevail with respect to the settlement of the vast aggregate of claims for commodities and service of every description that have remained unadjusted since the end of the war or the completion of war-time contracts. Because virtual inaction or indecision on at least two out of three general responsibilities above enumerated has characterized the regime of the Shipping Board awaiting reorganization there is a temptation to hail any determination as a new policy. Actually, though, the newly appointed Board will but energize a program that was a foregone conclusion.

This is particularly true with respect to the disposition of that large proportion of the governmental fleet which has no profitable employment. It was a foregone conclusion that, sooner or later, Uncle Sam must place on the auction block the heavy accumulation of tonnage, the value of much of which has been shrinking day by day. But administrators, appalled by the losses already incurred in the shipbuilding venture of the United States, have hesitated at the major operation of writing off the immense depreciation that must be charged to the war. The new administration, faithful to a platform that calls for the withdrawal of the government, has at least had the courage to decree the sale, for what it will bring, of the idle and useless tonnage that to the tune of millions of deadweight tons has been tied up for months past.

### Time Required to Dispose of Fleet

With the best intent in the world the Shipping Board will be unable, according to qualified, practical men, to dispose of the fleet in less than two or three years. The orderly processes of execution will require time even in the case of tonnage such as the wooden freighters of which the government desires to be rid as speedily as possible. Furthermore, there is to be reckoned with a class of modern, serviceable steel tonnage which may not consistently be sacrificed to bidders merely out of a desire to wipe the slate clean. The new Shipping Board will make every effort to dispose of its steel tonnage as expeditiously as may be but, if it appears that the stagnation of commerce and the depression in the shipping industry have demoralized the market for vessel property, it will be the policy to bide time for a reasonable interval in the hope that there may be a return to something approaching normal status.

For all the determination of the reorganized Shipping Board to get action wherever action is possible it seems likely to find, ere long, that it is beyond its power to effect the sale of the Government's ships even though it place them on the bargain counter. With the spectacle of 685 steel ships tied up at a cost of approximately $900 per month per ship and 274 wooden ships tied up at an expense of $100 a month per ship it has appeared to many of the taxpayers of the country that heroic measures were justified to get rid of the encumbrance. In reality, however, the sales division of the Shipping Board has not sat with hands folded while the value of the fleet was whittled away.

### Efforts to Sell Wooden Ships

For months past effort has been made to sell the wooden ships at virtually any price the market would afford but with limited success. The ships have been advertised abroad and a "sample ship" was sent to Naples in an effort to interest foreign purchasers in this class of tonnage. Meanwhile, American purchasers have virtually declined to touch the proposition because the high cost of operation of wooden vessels as compared with steel vessels rendered it problematical whether any profit could be earned. The question has often been asked by critics of procrastination why the Shipping Board did not, months ago, sell its surplus craft and particularly the wooden vessels for what they would bring.

Inasmuch as the reorganized Shipping Board is to be driven to this extremity, after millions of dollars have been expended for upkeep, the question is an appropriate one. The answer is that the sales division of the Shipping Board, alike to many another victim of a falling market, was always a bit behind the recession in the readjustment of prices. For example, the Shipping Board had been getting from $30,000 to $35,000 for wooden hulls on the Atlantic Coast and accordingly it scorned tentative offers of $8,000 to $10,000 for similar hulls on the Pacific. There was talk of towing some of the hulls from the west coast to the east coast to find a better market but meanwhile the market went from bad to worse, leaving the Board with some seventy-five hulls on the west coast. Thus it was only by the gradual



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persuasion of the inevitable that the executives at the head of the sales division came to the point where they realized that it was the lesser of two evils to sell wooden hulls at $10,000 and steel tonnage at $40 to $55 per ton, if responsible customers could be found.

### DEFERRED PAYMENTS ON PIONEER SALES

No less disturbing in the sale situation, though all unrealized by the great majority of outsiders, is the crisis that has developed with respect to payment for the vessels which have been sold on the deferred payment plan. The indebtedness from ship sales, etc., exceeds $17,000,000 and presents one of the most perplexing problems that the new Shipping Board finds on its doorstep. The gravity of the situation may be surmised from a recent confidential statement by Mr. Philbin, of the division of sales, that in his opinion unless some adjustment of prices is made every vessel that has been sold by the Shipping Board on a partial payment plan will be returned to the Board.

To visualize the situation with respect to payments on ships, it is necessary to bear in mind that the Shipping Board in the beginning undertook to sell ships on three or four different plans of deferred payments. In many instances the payments were based on the earning conditions which then obtained and which were such as to suggest that a vessel would earn its purchase price in a comparatively brief space of time. A number of the purchasers had paid anywhere from 25 to 40 percent of the purchase price when they were hit by the slump induced by the scarcity of cargoes and falling freight rates. In the face of the collapse it has been virtually impossible for the shipping men who are in this predicament to meet their obligations. The Shipping Board has brought to bear, for the collection of the outstanding $17,000,000, such pressure as it dare apply but always it has been restrained and the new Board will have to continue to be restrained by that moderation disregard of which would discredit shipping securities and invite the demoralization of the entire shipping industry.

It is conceded by the sales executives of the Shipping Board that many of the small shipping companies that began business during the war or immediately afterward and purchased vessels from the Shipping Board are no longer solvent, their assets having been wiped out in the continued operation of the vessels under the present conditions. The companies that are solvent are unanimous in appeal to the Shipping Board to readjust prices in order that they may secure their equities. A number of ship sale cases have been referred by the Shipping Board to the United States Department of Justice. However, officials in the sales division who are familiar with all the circumstances of the transactions say privately that they think it highly questionable whether any moneys can be recovered for non-performance of purchase contracts or any satisfaction obtained via foreclosure under mortgage because of the depreciation of marine securities which necessarily has direct relation to the valuation placed upon vessels and to their paper assets. It has been demonstrated that it would be to the advantage of the average purchaser, who is in this plight, if he could have his contract annulled and re-purchase his vessels at the new prices to be fixed by the Shipping Board.

### ARBITRATION OF CLAIMS

Most promising of results in the proclaimed policies of the reorganized Shipping Board is that which will seek to dispose by arbitration of the claims against the Board, arising out of cancellation of contracts, etc., and which amount in the aggregate to more than $300,000,000. The presence on the board of arbitrators of a practical shipping man is expected to safeguard the interests of claimants in even greater degree, perhaps, than was possible when the Shipping Board appeared in the dual role of judge and defendant.

No inconsiderable proportion of the pending claims are of foreign origin. Included in the number are the Norwegian claims which have been the subject of much discussion and the arbitration of which is provided for by the agreement between the United States and Norway which was lately sent to the United States Senate for ratification. There are payments due on the vessels under construction in China, and there are claims by Japanese steamship operators aggregating about $600,000. This last is a relatively small amount and the fact that settlement has not been made is explained by the inability of the Shipping Board auditors to make, to date, an examination of the accounts of the Japanese ship operators. The claims embody excessive time allowances for the employees on board the ships during the time they were within the war zone and it is the desire of the Shipping Board to check up on this. Set over against the claims against the Shipping Board by foreign countries or alien subjects, the Board has certain accounts to collect from foreign powers, notably the $12,000,000 due from the British government for the transportation of fuel oil.

### ABLE SHIPPING MAN FOR DIRECTOR OF OPERATIONS

The first confession of consternation over the magnitude of his new task which came from the new chairman of the Shipping Board took the form of an expression of determination to draft for the division of operations the ablest practical shipping executives that could be obtained and to pay in these positions salaries sufficient to compensate men of this caliber. The reorganized Board's policy of ship operation is one policy that is in a state of flux. It will not be surprising if it undergoes, during the next few months, not one but a number of revisions, each more or less radical. This is due to the fact that there is the sharpest divergence between the policy of ship allocation, which has heretofore been followed by the Shipping Board, and the "bare boat" charter system which is favored by so many private ship operators. It is urged by members of the American Steamship Owners' Association that the bare boat charter system would enable the Shipping Board to curtail to a considerable extent the heavy overhead with which it has been burdened and that its adoption would be a logical initial step in the transfer of the entire Government fleet to private ownership.

It has been customary, in describing the routine that has heretofore been followed by the division of operations, to say that the Shipping Board, in execution of a policy of allocation, has granted or executed charters. This is not an entirely accurate designation. The bulk of the Shipping Board's vessel now in commission has been placed in the hands of managing agents under an agreement called a managing agent's agreement. At last account there was on the roster an aggregate of 83 managing agents of cargo steamers, 7 tugboat operators and 3 tank steamer operators. Included among the managing agents are old-established steamship companies which operate vessels of their own as well as Shipping Board tonnage. Likewise there are companies that have been formed for the purpose of operating Shipping Board vessels. All told, the managing agents had in operation, at the latest date of computation, 621 ships. The managing agent is, of course, paid a commission on the gross revenue of each ship regardless of whether or not the ship operation shows a profit. Different percentages apply to different classes of cargo. On a cargo of one commodity, loaded at a single port, the allowance has been 2.5 percent of the gross freight list whereas on a ship carrying general cargo, covered by numerous bills of lading, the commission has been 5 percent. This scale has prevailed though the income of the cargo ships has been equalled or exceeded by the actual cost of operation, save, of course, with cattle ships and refrigerator ships which have, in the deepest dip of the depression, earned small profits.

(*Concluded on page* 589)

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# Future Policy of the Shipping Board

## Shipowners and Operators to Co-operate—Mr. Lasker Given Authority to Draft Best Brains for Key Men

**By Harold F. Lane**

A NEW plan of organization for the United States Shipping Board was announced on July 11 by chairman A. D. Lasker by which the Emergency Fleet Corporation will be revived to operate the government-owned ships, with members of the board as trustees and Chairman Lasker as president, and with a practical operating board consisting of five vice presidents who will be given full authority subject only to the decisions of the Shipping Board on questions of policy. The vice presidents will proceed to reorganize the departments under them.

Mr. Lasker announced the appointment of three vice presidents in charge of operations, J. Barston Smull, of the firm of J. H. Winchester & Company, ship brokers, New York; William J. Love, until recently manager in New York for Furness, Withy & Comany, Ltd., of Great Britain, and A. J. Frey, general manager of the Los Angeles Steamship Company. They will have charge of the allocation and chartering of ships, traffic and physical operation, but the exact division of their duties has not yet been determined upon. Elmer Schlessinger, general counsel of the Shipping Board, will also be a vice-president of the Fleet Corporation and Chairman Lasker went to New York on July 12 to select a vice president in charge of ship sales and salvage. There will be a new treasurer and Alonzo Tweedale will remain as general comptroller, while R. H. Montgomery will represent the chairman and the board in making a complete reorganization of the auditing system and an inventory of the assets of the board, which it is hoped to complete within 60 to 90 days. Clifford W. Smith, who has been connected with the Associated Press, has been appointed secretary of the board and of the Fleet Corporation, succeeding John J. Flaherty. W. B. Keene, the present acting director of operations, will remain in the operating department.

### Authority for Reorganization

The plan of organization was unanimously adopted by the board and approved in detail by the President. Under the Jones act there is authority for the use of the Emergency Fleet Corporation but there is a question as to its status if the president issues a proclamation terminating the technical state of war. However, the President has promised that if it becomes necessary he will undertake to obtain from Congress the legislation required.

In making the announcement to the Washington correspondents Chairman Lasker took occasion to discuss in considerable detail the policy of the Board, which proposes to function in such a way as to turn the operation of the ships over to private enterprise as soon as practicable.

"We have $300,000,000 in law suits and claims, which, of course, we will undertake to defend in such manner as to see that the government is protected and every claimant receives his dues," Mr. Lasker said. "We have scores of millions of property to salvage, and we will undertake to do that in such a way and at such a time that we will get its true worth. But, hypothetically speaking, if we gave away the salvage and if we lost all the law suits, the money cost would be measured and not continued. It would be the total amount already invested. But operations is another matter. The loss there cannot be measured; unless corrective measures are applied it would be continual and unending. And again, unless operations should be done efficiently, the American merchant marine will never be established on the high seas. So that while law suits and salvage can cost the Treasury a great deal of money if not efficiently done, in the end it has nothing to do with the successful operation of the fleet. All in all it is the success or failure of operations that will furnish the final answer.

### Spirit of Cooperation

"The Shipowners' Association of America and the Ship Operators' Association of America have shown the most magnificent spirit of cooperation with the new Shipping Board, and have by evidence proved to the new Shipping Board that they want to enter into a true partnership with it for the upbuilding of the American merchant marine. The ones who know best how to operate ships are the owners and operators, and they were unanimous in the recommendation that ship operations should be under one man. But it seemed otherwise to the board, because the operations of the fleet under its control are so infinitely greater than anything ever undertaken by other men, that the mere experience of the past could not be a sure guide to the future. The biggest privately owned fleet known today has, I think, 107 ships in it. Leaving out the wooden boats, we have 1,440 ships. It is no secret that our business and organization are not in smooth running condition; and no one man could possibly solve the problems presented, both because of lack of time and because they present such diversified problems that no one mind could grapple with them.

"We asked the shipping world to recommend the best talent to us for the positions determined upon, and told them we would take no one save those recommended by them, though we did not promise to take the first, second or third that they recommended; and we would only take outsiders if they utterly failed to present to us men whom we could accept. I met with the men recommended by them, every one of whom came believing in one man for operations; and with one exception, after we showed our situation to this man, you could not have gotten that man to come if he was to be the only man.

### Three Men Selected

"Mr. Smull is a half owner in one of the largest, if not the largest, ship brokerage firms in America. His firm has an income of about $500,000 a year, and his share is $250,000. He was the unanimous choice of the shipowners' and ship operators' associations for the position of chief of operations of the fleet, and to a man every shipowner and operator described him as the only man they could agree on to operate the fleet. I remained for 12 days in New York with Mr. Smull, getting his refusal day after day, and day after day telling him, 'They have convinced me that you are the man who, if associated with us, will make the promise of success pretty sure, and without you I don't think we can succeed.' He not only has the confidence of owners and operators, but shippers as well, because he is known to every shipper. He was chairman of the chartering committee of the American ships during the war, and throughout the world it was recognized as the finest piece of chartering work done in any of the allied countries. Day after day, because of the great length of time he had given to the government before and during the war, and because of present conditions in his own busi-



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ness, he refused to come. But on Saturday he yielded, on condition that he was satisfied with his interview with the board and the President; and he was satisfied. They put up to us several alternate men if we could not get Mr. Smull, but none of these alternate men had a unanimous vote. After I met Mr. Smull I became convinced that he was in every way an ideal man.

"Mr. Love, I might say, was the unanimous choice of the ship operators, and when he was selected, the shipowners joined in feeling that he and Mr. Smull represented the best that the eastern seaboard could put forward. Mr. Love is the New York manager of the largest British firm doing business in this country. He is an American citizen, born in America, and considered possibly the best expert in this country on traffic matters in connection with ships, and knows conditions throughout the United States and the world, particularly how the British have operated their merchant fleets so successfully.

"From the West we have selected Mr. A. J. Frey, who was assistant to the president of the Pacific Mail Company when it had its large fleet, and at that time was the most successfully operated American-owned concern.

### To Have Free Hand

"The work will be divided among these three vice presidents, and the policies in connection with the operating, chartering and disposal of ships will be initiated by them to the board. The board has invited them in on the basis of an absolutely free hand in the operation of the boats after a policy shall have been decided, and they have the assurance of the board and the President that there will be no political interference of any nature. The President has urged upon them the absolute necessity of operating these boats on the basis that they represent all the stockholders, who are all the people of the United States, and that efficiency alone, and that which lends to efficiency, should be compelling in their decisions on personnel and on their actions.

"The President and the board feel greatly encouraged that men of the type announced have accepted these appointments. The sacrifice, such as Mr. Smull for instance is making, is beyond measure. The sacrifice Mr. Love and Mr. Frey are making in leaving their well-ordered business is the best evidence that we can get the best brains of the country into the operation of the Shipping Board; and the Shipping Board cannot excuse itself for failure, if it does fail, on the ground that it cannot get around it the highest type of men able to do the work. If we fall down in that direction it will be our own fault, and there will be no chance for an alibi. It will take a year of the hardest kind of work and of the most efficient kind of work to bring the first semblance of order out of the chaos that exists. But we do not only feel hopeful and encouraged; we feel that the coming to us at such sacrifices of these men and other men with whom we are negotiating leaves us every reason to believe that the best ideals concerning the American merchant marine can, with patience on the part of the public and Congress, come to be a permanent reality.

### Salaries and Duties

"As to salaries, the three operating vice presidents will get between them a total of $95,000, which will be divided approximately equally. The operating headquarters will be in Washington. Where we have branch offices each vice president will select his own district manager, who will be attached to the branch office, but the general manager for each branch office will be selected by all the vice presidents. Each vice president will have sole control of the selection of all the men under him. It has not been determined how operations will be divided, but Mr. Smull may have allocation and chartering of ships; Mr. Love, traffic, and Mr. Frey have physical operations. Each will select his own men.

"The Shipping Board loses no control whatsoever as contemplated by the law. All the policies must be initiated by those men and submitted to the Shipping Board for the Shipping Board to adopt. But, once adopted, these men will have a free hand in their execution. Each operative head will be in charge of a certain character of work, but they may change it into territories. When it comes, however, to making recommendations for policies, the three will have to be in agreement. We are undertaking to make them as free in the management as if they held similar capacities with any big corporation.

### Key Men Available on Request

"The President, the Jones Act and the Shipping Board are all in accord that the Shipping Board must function so as to turn these boats over, as soon as good business judgment dictates, to private owners. Unless Shipping Board boats are very soon operated along the most correct business lines, we will not have any operators or owners left in America who can buy these boats. The operators and owners unanimously feel that way; and to get Shipping Board operations on an efficient basis is the quickest and shortest step to creating a situation whereby private people can buy these boats and get the government out of government ownership. It is for that reason that the shipowners and operators have unanimously agreed to something which I think is unique in government relations with private industry—that if they have any key men whom we want and who are vital to them, but who are vital to us, we are to get these key men on request, and they are not to let us know that it is a calamity to them.

"New routes will be one of the assets we will try to sell. Another phase is this: Supposing there is a route and two ships are on it, one privately owned and one government owned, and it will only stand for one ship. It is our idea that we will take out of service the government-owned boat and leave in the privately-owned boat, because if we bust the private company, whom will we have left to buy the boats when business gets good enough to have two lines?

"The appointment of Messrs. Smull, Love and Frey will mean a new day in the minds of shippers, and you don't want to forget that in this equation. Shippers have lost confidence in the government-owned ships. They have not sailed on time, they have not arrived on time, and the goods have not always been in good condition when they have arrived. By the time they get the answer as to whether we will charter them a ship, that business is often loaded in foreign bottoms. The coming of Smull, Love and Frey will give a wholly different atmosphere to American shippers. They will know it will not change the next day. And there is not a shipper who does not know these names as a music lover knows Caruso or a baseball lover knows Babe Ruth. And they will know that these men will do it; and that is what we mean when we say that through efficiency we will build up an American merchant marine."

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President Harding has submitted to the Senate an arbitration agreement providing for the adjustment of claims of Norwegians against the Shipping Board aggregating $14,157,000 for 15 vessels taken over by the board during the war. The vessels were being constructed in American yards for Norwegians when they were requisitioned. The claims were taken up by the Norwegian Government through diplomatic channels after the claimants and the Emergency Fleet Corporation had failed to reach an agreement.

* * *

The Shipping Board in response to appeals from the Wisconsin Legislature and states on the Great Lakes has delegated Commissioners O'Connor, Benson and Plummer to make an investigation of the operation of package freight boats on the Great Lakes.

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# British Frozen Meat Cargo Steamer Tairoa

*This article describes in detail the method of insulating a meat refrigerator vessel with silicate cotton and cow hair as practiced at the works of Sir W. G. Armstrong Whitworth & Company, Ltd., Newcastle-on-Tyne, England. The "Tairoa" represents a class of vessel of which there is at present a shortage in the American merchant marine.*

THE *Tairoa* is a shelter deck type of vessel with a combined bridge and poop and a topgallant forecastle. Three decks are fitted, the second or main deck extending from stem to stern except in way of machinery spaces and the upper and shelter decks are continuous the full length of the vessel. The main propelling machinery is located in two compartments amidships and consists of two surface condensing, vertical, quadruple expansion engines of 5,000 indicated horsepower. Steam is generated in four cylindrical boilers, two being of the single ended and two of the double ended type.

Five main cargo holds are provided, three forward of the machinery spaces and two aft. Holds Nos. 1, 2, 4 and 5, with their adjacent 'tween deck spaces between the upper and second decks, are insulated for the carriage of refrigerated cargo and cooled by an installation of the brine pipe system of $CO_2$ refrigeration.

The particulars of the insulation fitted are as follows:

### Material

The insulating material is silicate cotton of best quality with washed cow hair in certain portions. All grounds are of best quality white deal, coamings and all framings of pitch pine and the matching throughout of white deal of good quality. The matching is tongued and grooved but not beaded.

### Bottom Insulation

Angles 4 inches by 3 inches with the large flange vertical are riveted to the tank covering plate, 3 inches inboard from the line of limbers, on each side for the complete length of the hold and calked watertight. After fitting, these angles and the tank top were coated with ½ inch of Wailes Dove's bitumastic cement. Coamings 2½ inches thick of suitable depth are securely bolted to these angle bars and between these coamings, across the tank top, grounds 8 inches by 3 inches are laid over each floor. In way of the hatchways, and extending two floor spaces beyond the hatch at each end, intermediate grounds are laid. On the top of these grounds two thicknesses of white matching, 1 inch and 1½ inch respectively, are nailed and underneath the hatchways seasoned elm doubling 2 inches thick is spiked down, extending in Nos. 1 and 2 holds 2 feet further in each direction than the hatchway above, the edges being chamfered and the seams calked and payed with marine glue.

In Nos. 4 and 5 holds the doubling extends between the tunnels to the forward bulkhead and is carried over the tunnel grounds and 4 feet on the floor from the outer side of each tunnel.

### Turn of Bilge

Grounds 3 inches by 2 inches are bolted on the face of each floor and are carried up as far as the first stringer. Over these are nailed two thicknesses of 1¼ inch white matching with grounds 5 inches high by 3 inches thick in line with each floor and covered over with two linings of 1 inch and 1½ inch respectively, the space between being packed with silicate.

### Bilge Scuppers

The trap scupper is fitted through the end bilge hatches, on each side, in each insulated hold. The scupper is arranged vertically in the bilge 1 inch clear of the grounds when the hatch is in position, a wooden cage being built over the top of each scupper.

### Limber Hatches

A double line of limber hatches is fitted fore and aft in each compartment, also thwartship hatches between the tunnels in way of scupper pipes, etc., in Nos. 4 and 5 holds. Those into the bilges have a clear opening of 1 foot 9 inches and are constructed as follows:

The sides of 2 inches, the top and bottom of 1¼ inch and 1 inch respectively and the inner linings of ¾ inch, the coamings 2½ inch thick, each hatch being filled with 5 inches of washed cow hair. These hatches, which in no case exceed two frame spaces in length, are fitted with 2 inches by 5 inches stiffening grounds, one in the center and one in way of each ring bolt. Each stretch has three key hatches and a plug in the bulkhead to give access to the end bays. Each hatch has two ¾ inch galvanized iron ring bolts and nuts secured through stout washers with an oval hole in the top washer to permit the ring to lie flat on the hatch. Grating hatches of heavy material and Troop pattern are supplied, being fitted in way of all cargo hatches for ventilating purposes.

### Manhole Openings

Around each manhole a 4 inch by 3 inch angle bar with welded corners is riveted down to the tank top and calked watertight. Frame coamings 2½ inches thick and of suitable depth are securely bolted to the underside of the angle bar into which are fitted hatches similar in construction to those specified for limbers.

### Tunnel Recess

Top sides and end are fitted with grounds, etc., and insulated with 12 inches of silicate in a manner similar to the bulkhead adjoining, but the covering boards are each 1¼ inch matching.

### Tunnels

Grounds 10 inches deep by 3 inches thick were cut to the sweep of the tunnel and attached with ¾ inch bolts to the stiffeners. To these are secured two thicknesses of 1¼ inch matching, breaking joints, the intervening space being tightly packed with silicate cotton. A portable strake 12 inches wide on the crown of the tunnel is fitted for sight purposes, secured in place with stout brass screws. American elm hoops 2½ inches by 2½ inches bent to shape and having the upper edges chamfered are secured round the tunnel spaced 9 inches apart. Elm chafing blocks, spaced 20 inches between centers, 3 inches thick and of sufficient depth to protect the brine grids are securely fastened to the side of the tunnel.

### Side Insulation

Grounds 3 inches by 2 inches thick are bolted to the face of the channel frames, these grounds being well bedded on thickly painted tarred felt and secured in place with ⅝ inch bolts spaced not more than 3 feet 6 inches apart. On the face of the grounds two thicknesses of matching ¾ inch and 1 inch respectively are nailed, the space between the boarding being tightly packed with silicate cotton. The first stringer above the turn of the bilge in each hold was made



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# British Frozen Meat Cargo Steamer Tairoa

## General Information

**Service:** Refrigerated Freight
**Builder:** Sir W. G. Armstrong Whitworth & Co., Ltd., Newcastle-on-Tyne, England
**Propelling Machinery:** The North Eastern Marine Engineering Co., Ltd., Wallsend-on-Tyne, England.
**Owner:** Shaw Savill and Albion Steamship Co., Ltd., London, England.

## Characteristics

| | |
|---|---|
| Length, overall | 494'-0" |
| Length, B. P. | 477'-0" |
| Breadth, molded | 62'-9" |
| Depth, molded, shelter deck | 42'-10" |
| Depth, molded, upper deck | 34'-4" |
| Draft, loaded | 28'-10" |
| Draft, light | |
| Height, second to upper deck | 11'-6" |
| Height, upper to shelter deck | 8'-6" |
| Height, shelter to bridge deck | 8'-0" |
| Block coefficient | |
| Midship section coefficient | |
| Longitudinal coefficient | |
| Speed, loaded, knots | 12.25 |
| Cruising radius, nautical miles | |
| Framing | Transverse |
| Class | Lloyds + 100 A1 |

## Tonnages

(In tons of 2,240 pounds)

| | |
|---|---|
| *Weight of Hull | |
| **Weight Propelling Machinery | |
| Deadweight Capacity | 11,050 |
| Displacement | |

(In tons of 100 cubic feet)

| | |
|---|---|
| Gross register | 7,983 |
| Net register | 5,048 |

*Weight of Hull includes Hull Proper, Hull Fittings, Equipment, and Outfit.
**Weight of Propelling Machinery includes Engines, Boilers (Wet), Shafting, Propellers, and Machinery Space Auxiliaries.

## Canal Ratings

(In tons of 100 cubic feet)

| | Gross | Net |
|---|---|---|
| Suez | | |
| Panama | | |

## Equipment

| | | |
|---|---|---|
| 2 Bower anchors, stockless | 94 | cwts. |
| 1 Bower anchor, stockless | 81 | " |
| 1 Stream anchor, ex-stock | 25 | " |
| 1 Kedge anchor, ex-stock | 12 | " |
| Cable, 2 9/16" stud chain | 300 | fms. |
| Stream line, 5¼" steel wire | 120 | " |
| Towline, 6" steel wire | 130 | " |
| 8" Manila lines (4), each | 100 | " |

## Rudder

| | |
|---|---|
| Area | |
| Dia. Stock | |
| C. Press. abaft C. L. pintles | |

## Complement

| | |
|---|---|
| Deck officers | 6 |
| Deck crew | 32 |
| Engineer officers | 9 |
| Engineer crew | 34 |
| Purser's and steward's department | 12 |
| Total officers and crew | 93 |
| First-class passengers | None |
| Second-class passengers | None |
| Third-class passengers | None |
| Total passengers | None |
| Total complement | 93 |

## Handling Equipment

| | No. | Type | Capacity | Length |
|---|---|---|---|---|
| Masts | 2 | Pole | Steel | .... |
| Derrick posts | 8 | Steel | .... | .... |
| Booms | 12 | Steel | 12 Ton | .... |
| Booms | 8 | Wood | 6 Ton | .... |
| Booms | 2 | Wood | 3 Ton | .... |
| Booms | 1 | Steel | 30 Ton | .... |

## Deck Machinery

(Number, Size, Type)

Steering Gear, steam, Wilson Pirrie patent type, telemotor control.
Windlass, steam, two cylinders, 10½" x 14"
Capstans
Winches, steam (15) 7" x 12"
Winches, steam (2) 9"x12"
Winches, steam (1) 8"x12"

## Life Saving Equipment

| | No. | Type | Length |
|---|---|---|---|
| Lifeboats | 2 | .... | 26'-0" |
| Lifeboats | 4 | .... | 28'-0" |

## Propelling Machinery

### Boilers

| | |
|---|---|
| Number | 4 |
| Type, 2 single ended, 2 double ended, Scotch | |
| Length | D. E. 21'-6", S. E. 12'-6" |
| Diameter | 15'-0" |
| Furnaces | 18 |
| Fuel | Coal |
| Draft | Forced |
| Total heating surface, sq. ft. | 15,442 |
| Total grate surface, sq. ft. | 356 |
| Superheat, degrees F. | |
| Working pressure, lbs. per sq. in. | 220 |
| Normal fuel consumption: | |
| Per day, tons | |
| Per horsepower hour, pounds | |
| Normal steam production: | |
| Per hour per pound of fuel | lbs. |
| Total per hour | lbs. |

### Engines

| | |
|---|---|
| Number | 2 |
| Type | quadruple expansion reciprocating |
| Size | 22"x31½" x 45" x 65" x 48" stroke |
| Horsepower, indicated | 5,000 |

### Propellers

| | |
|---|---|
| Number | 2 |
| Type | 4 bladed built-up |
| Weight | |
| Diameter | |
| Pitch | |
| R. P. M. | |
| Projected area | |
| Developed area | |

## Auxiliary Machinery

(Number, Size, Type)

**Machinery Space**

Main condensers, Uniflux type capable of maintaining a steady vacuum of 26" with barometer at 30" and sea water at 89° F.
Auxiliary condenser (1); Uniflux type, 550 sq. ft. cooling surface, with 18x 10x10 air and 7 inch circulating pumps.
Evaporators (2), 30 ton and 24 ton capacity.
Distiller, capacity 1,000 gal. of drinking water per 24 hours.
Filter feed, 4 inch double.
Feed water heater 25" direct contact
Fuel oil heaters
Drain tank 300 gallons

**Pumps**

Feed (2); 5¾x24.
Bilge (2); 5½x24.
Sanitary (2); 5x24, double acting.
Independent feed (2); 13½x10x24.
Circulating (2); 14" centrifugal direct-driven.
Ballast (1); 10x12x12, double acting, vert. duplex.
Fresh water (1); 4x4x5, double acting vert. duplex.
General service (2); 9½x7x21, single cyl., double acting vert. feed type.
Forced draft fan 108" diam., driven by 2 enclosed type engines 9 x 6½, with forced lubrication.

**Refrigerating Machinery**

One duplex machine of Haslam type, carbonic anhydride system; ice melting capacity per 24 hours, 114 tons; 4 electric driven air circulating fans.

**Electric Equipment**

Generators (2), 20 k.w. at 100 volts, direct driven.
Radio 1½ k.w. installation
Emergency

## Holds

| No. | Length | Hatches |
|---|---|---|

## Capacities

### Cargo Space.

| Compartment |
|---|

### Refrigerated Space

| Compartment | Cu. Ft. |
|---|---|
| Insulated cargo chambers | 314,345 |

### Bunkers

| Compartment | Cu. Ft. | *Bbls. | *Tons |
|---|---|---|---|

....cu. ft. per ton; ....gals. per bbl.

### Tanks

| Compartment | Cu. Ft. | Tons F.W. | Tons S.W. |
|---|---|---|---|
| Total capacity of double bottom tanks (F. W. & S. W.) | | 1,514 | |
| After peak (Ballast) | | | 42 |



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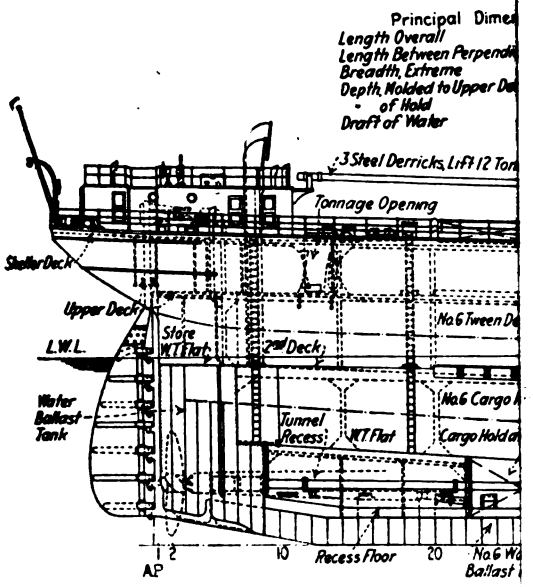


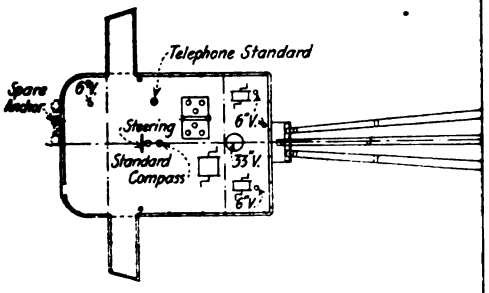


TOP OF STEERING GEAR HOUSE.

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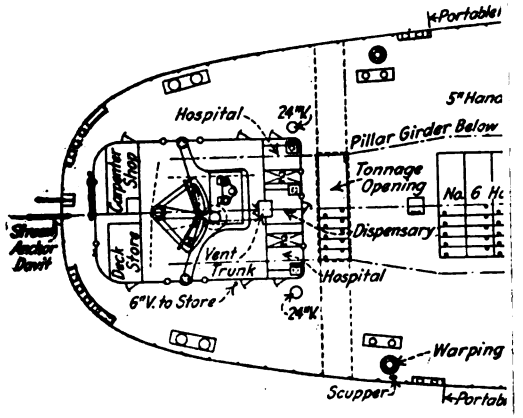


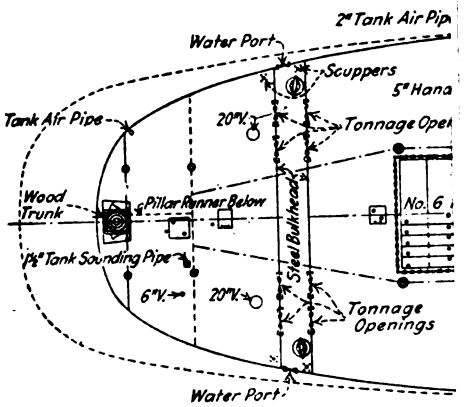


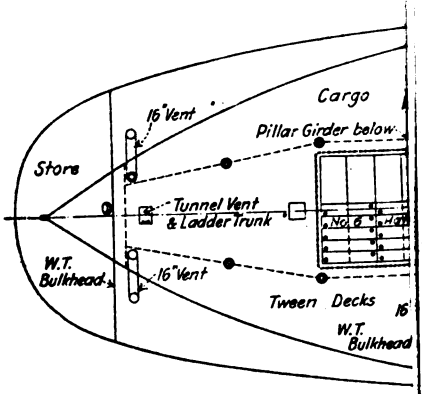


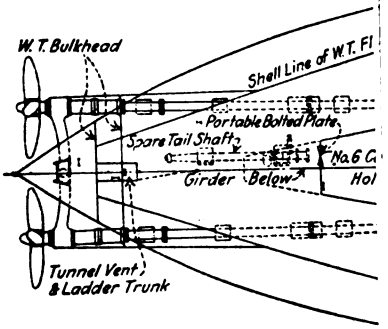


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| | |
|---|---|
| Length Overall | 499'-0" |
| Length on Upper Deck | 491'-7" Lloyds Length |
| Length between Perps on W.L. | 477'-0" |
| Breadth Extreme | 63'-1" |
| Depth Molded (to Upper Deck) | 34'-4" |
| Depth of Hold | 31'-3" |

Class:-Lloyds +100 A.1. Shelter Deck with Freeboard

### SCANTLING NUMERALS

Transverse Number (B+D) = 67.75 + 34.33 + 50 = 97.58
Longitudinal Number L × (B+D) = 477.6 × 97.58 = 46,604
d = 18.96
L/D to Bridge Deck = 9.38 L/D to Shelter Dk. = 11.12

### EQUIPMENT NUMERAL

| | | |
|---|---|---|
| Longitudinal Number | L × (B+D) | = 46,604 |
| Shelter Tween Decks | 477.6 × 8 × .75 | = 2865 |
| Bridge " " | 180.5 × 8 × .75 | = 1083 |
| Forecastle " " | 49.93 × 8 × .75 | = 300 |
| Engine Casing & House | 40.00 × 7.5 × .5 | = 150 |
| Boiler " " " | 38.00 × 7.5 × .5 | = 143 |
| Officers' House | 33.00 × 7.5 × .5 | = 124 |
| | Equipment Numeral | = 51,269 |

### EQUIPMENT

| | | | |
|---|---|---|---|
| 1 Bower Anchor (Stockless Type) | 85¼ Cwts. | +10% | = 94 |
| 1 " " " " | 85¼ " | +10% | = 94 |
| 1 " " " " | 73½ " | +10% | = 81 |
| 1 Stream " (Ex Stock) | 25 " | | |
| 1 Kedge " " " | 12 " | | |
| 300 Fathoms 2⅞" Stud Chain Cable | 989 Cwts. | | |
| 120 " Steel Stream Wire | 5¼" | | |
| 130 " " Wire Tow Line | 6" | | |
| 100 " Manila | 8" | | |
| 100 " " | 8" | | |
| 100 " " | 8" | | |
| 100 " " | 8" | | |

### FRAMES

Frames in After Peak 7" 3½" × 3½" × .427 Angles spaced 28" apart to Shelter Deck.
Main Frames clear of Bridge 9" × 3½" × 3½" × .46 Channels spaced 28½" apart to ¾ L Forward from Margin to Shelter Deck.
Main Frames in way of Bridge 9" × 3½" × 3½" × .46 Channels spaced 28½" apart from Margin to Shelter & Bridge Decks alternately except for a Distance of ¼ the Breadth of the Vessel inside Ends of Bridge, where Frames extend from Margin to Bridge Deck on every Frame.
Frames Forward of ¾ L to Collision Bulkhead 10" × 3½" × 3½" × .475 W × .50 F spaced 27" apart from Margin to Shelter & Forecastle Decks.
Frames in Fore Peak 9" × 3½" × .45" Bulb Angles spaced 26" apart to Forecastle Deck.
Intermediate Frames in Bridge Tween Decks 4" × 4" × .427 Angles.
Main Frames in way of Coal Bunkers increased ⅝".
Reverse Frames in After Peak 3½" × 3½" × .427 to Upper Deck.
Reverse Frames on Main Frames for ¾ L Amidships 3½" × 3½" × .46 to 2nd Deck increased ⅝" in way of Bunkers.
Reverse Frames Forward of ¾ L to Collision Bulkhead 3½" × 3½" × .50 Angles on Frames 176, 177, 179, 181 & 183 - 6" × 3½" × .55 Angles on Frames 175, 178, 180, 182 & 184 to 192 inclusive all to Upper Deck.
10" × 3½" × 3½" × .475 W. × .50 F. Channel Frames with 3½" × 3½" × .50 Reverse Bar from ¾ L to Forecastle Front.

### FORGINGS

Stem Bar 10" × 3⅝"
Stern Post 11" × 5½"
Rudder Stock 13⅜"
Includes 5% above Rules

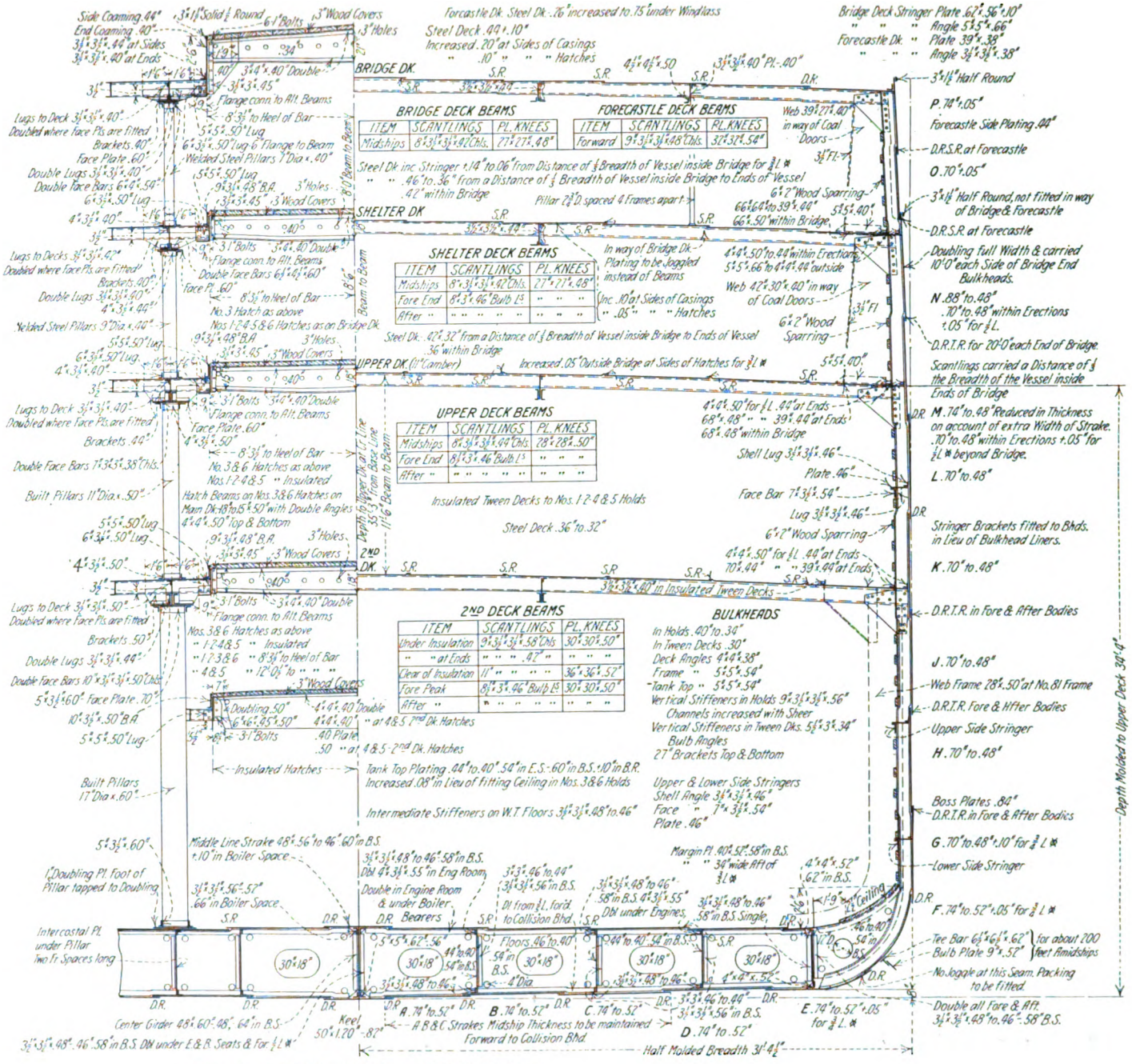
BRIDGE DK.
SHELTER DK
UPPER DK. (1/4" Camber)
2ND DK.
BRIDGE DECK BEAMS
FORECASTLE DECK BEAMS
SHELTER DECK BEAMS
UPPER DECK BEAMS
2ND DECK BEAMS
BULKHEADS
Steel Deck .49" x .10"
Increased .20" at Sides of Casings
Increased .05" Outside Bridge at Sides of Hatches for ¾ L
Insulated Tween Decks to Nos. 1-2-4 & 5 Holds
Steel Deck .36" to .32"
Tank Top Plating .44" to .40" .54" in E.S. .60" in B.S. .10" in B.R. Increased .08" in Lieu of Fitting Ceiling in Nos. 3 & 6 Holds
Intermediate Stiffeners on W.T. Floors 3½" x 3½" x .48" to .46"
Insulated Hatches
Built Pillars 17" Dia. x .60"
Middle Line Strake 48" x .56" to 46" .60" in B.S. + .10" in Boiler Space
Intercostal Pl. under Pillar Two Fr. Spaces long
Center Girder 48" x .60" .48", 64" in B.S.
Keel 50" x 1.20" - .82"
Half Molded Breadth 31'-4½"
Depth Molded to Upper Deck 34'-4"
A. .74" to .52"
B. .74" to .52"
C. .74" to .52"
D. .74" to .52"
E. .74" to .52" + .05" for ¾ L
A, B & C Strakes Midship Thickness to be maintained Forward to Collision Bhd.
Double all Fore & Aft. 3½" x 3½" x .48" to .46" - .58" B.S.
Bridge Deck Stringer Plate .62" x .56" x .10"
Angle 5½" x 5" x .66"
Forecastle Dk. " Plate 39" x .38"
Angle 3½" x 3½" x .38"
3½" x 1½" Half Round
P. .74" x .05"
Forecastle Side Plating .44"
D.R.S.R. at Forecastle
O. .70" x .05"
3" x 1½" Half Round, not fitted in way of Bridge & Forecastle
Doubling full Width & carried 10'-0" each Side of Bridge End Bulkheads.
N. .88" to .46" .70" to .48" within Erections + .05" for ¾ L.
D.R.I.R. for 20'-0" each End of Bridge.
Scantlings carried a Distance of ¼ the Breadth of the Vessel inside Ends of Bridge
M. .74" to .48" Reduced in Thickness on account of extra Width of Strake. .70" to .48" within Erections + .05" for ¾ L beyond Bridge.
L. .70" to .48"
Stringer Brackets fitted to Bhds. in Lieu of Bulkhead Liners.
K. .70" to .48"
D.R.I.R. in Fore & After Bodies
J. .70" to .48"
Web Frame 28" x .50" at No. 81 Frame
D.R.I.R. Fore & After Bodies
Upper Side Stringer
H. .70" to .48"
Bass Plates .84"
D.R.I.R. in Fore & After Bodies
G. .70" to .48" + .10" for ¾ L
Lower Side Stringer
F. .74" to .52" + .05" for ¾ L
Tee Bar 6½" x 6½" x .62" Bulb Plate 9" x .52" for about 200 Feet Amidships
No Joggle at this Seam. Packing to be fitted.

**Fig. 3.—Midship Section of S.S. Tairoa**

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watertight with cement before the side insulation was put in place.

### BULKHEAD INSULATION

The bulkhead at the fore end of No. 1 lower hold and 'tween deck was treated as follows:

Twelve inch grounds 2½ inches thick spaced 26 inches between centers were bolted to the angle lugs or stiffeners and two linings of ¾ inch and 1 inch matching respectively were nailed thereto, the interior space being tightly packed with silicate.

The bulkhead at the after end of No. 1 lower hold had 8 inch by 2½ inch grounds bolted flush with the face of the 11 inch channels spaced 30 inches between centers. Over this, two thicknesses of lining ¾ inch and 1 inch respectively were worked. At the after end of No. 1 'tween decks the grounds were 8 inches by 2½ inches, the remaining details being as for the lower portion of the bulkhead.

The bulkhead at the forward end of No. 2 has grounds 3 inches by 2½ inches thick spaced 30 inches between centers attached to the bulkhead by angle lugs and treated with matching lining and silicate as before described. The bulkhead at the forward end of No. 2 'tween decks was treated similarly to the lower hold but with 4 inch instead of 3 inch grounds.

The bulkhead at the after end of No. 2 lower hold and 'tween deck was treated similarly to the bulkhead at the after end of No. 1 lower hold.

The bulkhead at the forward end of No. 3 lower hold and 'tween deck has grounds 4 inches deep by 2½ inches thick spaced 22 inches between centers and faced with two thicknesses of matching ¾ inch and 1 inch respectively filled with silicate cotton. The insulation in No. 3 hold is protected by galvanized sheet iron No. 16 B. W. G. secured with stout button headed screws spaced close together.

The forward bulkhead of No. 4 hold and 'tween deck has grounds 12 inches by 2½ inches spaced 30 inches between centers, the matching lining and silicate being as before described.

The bulkhead at the aft end of No. 4 hold and 'tween deck has grounds 4 inches deep by 4½ inches thick spaced 30 inches between centers attached to the bulkhead by angle lugs, the matching lining and silicate being as before.

The bulkhead at the forward end of No. 5 hold and 'tween deck has grounds 10 inches deep by 2½ inches thick spaced 30 inches between centers with similar lining and silicate.

The forward bulkhead of No. 5 lower hold is similar to the after bulkhead of No. 2 hold and the forward bulkhead of No. 6 hold similar to the forward bulkhead of No. 3 hold.

In each case the faces of the channel bars, etc., were covered with thickly painted tarred felt.

### STRINGERS

The projecting part of the stringer is covered with ¾ inch hair felt cased in with solid nosing.

### MEAT PORTS

These have heavy pitch pine frame coamings securely fastened to the frames and of suitable depth to allow of a plug of similar description to those described for manhole doors. Chafing plates of 3/16 inch galvanized steel, securely fastened with heavy brass screws, are fitted all round the coaming. Plugs are covered with Fearnought and retained in position with heavy galvanized iron bars bolted to the center plug and secured at the end with thumb screws.

### BEAM KNEES

On the outer edge of each beam knee 7 inch by 2 inch grounds projecting ½ inch beyond the face of the knee are securely bolted with two ⅝ inch bolts. Two thicknesses of lining, ¾ inch and 1 inch, respectively, are run on the face of these and the space between filled with silicate.

### LOWER HOLD BEAMS, STANCHIONS, ETC.

Grounds 7 inches by 2½ inches projecting ½ inch beyond the lower end of each beam are secured to the beam by ¾ inch bolts spaced 3 feet apart. Under the beams dry hair felt ½ inch thick is placed, one thickness each of ¾ inch and 1 inch matching nailed over all and the space tightly packed with silicate.

All ventilator and ladderway openings are framed out with pitch pine coamings 2½ inches thick and fitted with plugs and fastenings similar to those specified for meat ports. The tube pillars are insulated with ¾ inch of hair felt over which is tightly served 2 inch manila rope. The stanchions and ladders are also served with 2 inch manila rope stopped at frequent intervals.

### SIDE GIRDERS

The side girders have grounds of suitable depth bolted into position so as to give a minimum of 5 inch insulation and ¾ inch of hair felt on the bottom, the whole being covered with two thicknesses of ¾ inch and 1 inch matching lining.

### 'TWEEN DECK BEAMS, STANCHIONS, ETC.

In the 'tween decks the grounds project 1 inch below the beams giving 1 inch of hair felt, except in the brine tank room and 4 feet beyond, where the grounds project 2 inches below the beams giving 2 inches of hair felt.

### RIBBON INSULATION

The underside of the upper and main decks in Nos. 3 and 6 holds and in the fore peak for one beam space are treated similarly as the overheads in the adjoining insulated holds.

### BRACKETS

Brackets and gusset plates are covered on each cheek with dry hair felt ½ inch thick and clad with wood, through bolted.

### PIPES

Where pipes of any description pass through the insulated compartments suitable provision has been made for hanging them, together with plug ports for their examination.

All brine leads, pumps, bilge suctions, sounding and air pipes, etc., throughout the four compartments are efficiently insulated with not less than 8 inches of silicate with grounds and linings to suit their position.

### HATCHES

The upper and main deck hatches in the three compartments have coamings lined with sawn pitch pine timber bedded on thickly painted tarred felt and bolted through the coamings by ¾ inch bolts sunk beneath the flush and dowelled. The sawn timber has a minimum thickness of 3 inches at the top and increases in thickness to give a bevel of 4 inches at the foot, the lower corners being rounded. The underside of the hatch timber is rabetted out at the inner edge to receive the lower lining and matching in the overhead insulation and the bevelled sides are clad with 3/16 inch galvanized steel bent to shape and secured with heavy brass screws. Heavy galvanized wrought iron pieces are fitted to the lower corners of all insulated hatch coamings. Where wooden coamings project more than 2 inches below the iron coamings flat plate hangers are supplied. Hatch beams are treated in a similar way to hatch coamings.

The insulated hatch covers are constructed as follows:

Sides 2 inches pitch pine; top outer lining 1¼ inches; bottom outer lining 1 inch; inner linings of ¾ inch matching fitted with 3 inch by 6 inch stiffening grounds, one in the center and one in way of each ring bolt; each cover has 6 inches of washed cow hair firmly pressed inside; two ⅞ inch galvanized iron ring bolts with nuts secured through stout plate washers with oval holes in the top washer to admit of the ring lying flat are fitted to each hatch.

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On each side of the 'tween decks and hold insulation, meat battens 2 inches by 1¾ inches with the edges chamfered and spaced 9 inches apart are secured from the underside of the deck in line with the limber hatches.

### BRINE SERVICE, ETC.

Delivery and return brine leads serving the compartments are insulated with a minimum of 8 inches of silicate cotton, cased in with two thicknesses of 1 inch matching on grounds of suitable size, the whole being put together in sections which correspond to the lengths of pipes. The casings which pass through general cargo or bunker spaces are covered on the outside with galvanized sheet iron No. 16 B.W.G. carried up to the deck, fitted dust tight and neatly secured with brass screws.

### BRINE SERVICE PUMPS, ETC.

The brine pumps, brine return tanks, brine distributing boxes and service pipes and also the brine mains are insulated in a suitable manner. The brine grids on the sides and bulkheads of all chambers, holds, 'tween decks and tunnels are substantially secured, this being effected by wood chocks suitably spaced and secured with coach screws into the grounds of the insulation, the heads of these being again covered with hard wood strips. The brine pipes in the bunkers in way of Nos. 4 and 5 holds are protected at the sides with closed pitch heavy wood chocks. Where brine pipes pass through the deck the 6 inch by 3 inch angle iron coaming is riveted and made watertight and the intersections between the brine pipes securely filled in and grouted flush to the top of the angle bar with Wailes Dove bitumastic.

### SHIP'S PROVISION CHAMBERS

In addition to the spaces previously described the ship's provision chamber and vegetable rooms, etc., are located in the bridge space. The bottom of each compartment is covered with bitumastic cement ¼ inch thick. The floor of ¾ inch and 1¼ inch match linings is laid on bearers 3 inches wide by 2 inches thick spaced 18 inches between centers, the space between being filled with silicate.

The floor is covered all over and 18 inches up the sides of all compartments with 8 pound lead, bedded on Stockholm tar all joined, carefully soldered and fastened with copper tacks close up along the upper edges of the flashing. The sides have grounds 3 inches by 12 inches set up on edge to the underside of the deck overhead and covered with two thicknesses of lining ¾ inch and 1 inch thick, the space between being closely packed with silicate.

The ceiling has grounds of suitable depth bolted to the beams, the lower edges of which project 12 inches below the deck plates and are faced with two thicknesses of ¾ inch and 1 inch, respectively, the intermediate space being filled with silicate.

The floor is covered with 1¼ inch tongued and grooved matching on 1½ inch bearers in handy sections for lifting out and cleaning purposes. The underside of the shelter deck in way of the meat chambers, etc., but extending at least 4 feet more in each direction than the compartments above, is treated similarly to the ceiling above mentioned and is covered with galvanized sheet iron of No. 16 B.W.G. secured by brass button headed screws.

Hinged plug doors are fitted for access to the chambers. All insulated doors are fitted with Taylor's galvanized iron hinges and door fasteners of suitable hasps and staples for locking purposes.

Galvanized iron racks, shelves and meat hooks in both rooms are provided.

The bulkhead dividing the vegetable from the meat room is framed with 6 inch by 2 inch grounds spaced 2 feet apart and faced on both sides with two thicknesses of ¾ inch and 1 inch matching, the intervening space being filled with silicate.

The underside of insulation in way of limbers, etc., was given three coats of paint.

All woodwork, except floors, received three coats of varnish.

### VENTILATING DUCTS

These are suitably insulated with the necessary plugs similar in every detail to those fitted in meat ports and secured in place with similar arrangements.

All the wood used for grounds throughout the whole of the insulation, as well as lower linings at the turn of the bilge as high as the first stringer, were first treated with a zinc chloride or Burnettizing process.

## Acetylene for Ship's Lighting

THE Marine Department of the Board of Trade has just issued the following instructions to surveyors in respect of acetylene for lighting purposes:

1. The generator should comply with the regulations as to acetylene generators issued by the British Acetylene and Welding Association.

2. No copper, compo, or flexible piping should be used for conveying the gas from the generator to the burners. Preferably the pipes should be of solid drawn steel or brass, the former being tinned to prevent corrosion, but they should not be copper plated. After the pipes have been installed on board, they should be suitably tested, and in no circumstances should a naked light be used.

3. Each generator should be furnished with an automatic cock or other similar contrivance, so that the gas will be automatically shut off the main distributing pipes when the pressure in the generator is practically exhausted.

4. A distribution box should be fitted near the generator, to which the distribution pipes conveying the gas to the various burners should each be connected by means of a shut-off cock, so that when the pressure of gas in the generator is exhausted the entire supply of acetylene can be shut off from the burners. A conspicuous notice should be affixed near the distribution box to the effect that:

"When the pressure of gas in the generator is nearly exhausted, or the generator is out of use, the various cocks in the distribution box should be shut, and should not be opened again to any compartment until an assurance is given that the burners in that compartment are shut."

5. A properly constructed metal storage container fitted with a jointed cover so that it can be hermetically sealed, should be provided near the generator for the storage of the carbide of calcium. A conspicuous notice should be affixed near the generator and storage container to the effect that "No naked light is allowed near the generator or the carbide container."

6. It is understood that the carbide of calcium is usually delivered on board in the ordinary commercial drums weighing 50 or 100 kilograms. For convenience of handling and safety, it is strongly recommended that smaller packages be employed for this purpose. No serious objection need, however, be raised at present to the use of the larger drums provided a suitable eye-bolt is fitted to the engine room skylight and blocks and tackle furnished. The owners should issue a warning to the engine man that immediately the carbide of calcium is delivered, or at any rate before the vessel proceeds to sea, the carbide should be removed from the drum in which it is delivered into the storage container, and further, that the blocks and tackle must be employed to lower the drums into the engine room. Neglect to adopt this simple precaution has resulted in one instance in loss of life and in serious danger to the entire crew.

7. Carbide drums should not be opened by the use of a hammer and chisel, but a suitable carbide drum opener should be used. In handling carbide and charging the generator, care must be taken to avoid the creation of sparks.

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# Are You a Marine Engineer, Edison Standard?

## Questions That Mr. Edison Might Ask His Engineers If He Were in the Shipping Business

**By "Old Scotch"**

THE publication of one hundred test questions for applicants for positions in Thomas A. Edison's industrial enterprises aroused a wave of interest throughout the country. They are said to have floored honor men who had graduated from some of our leading colleges and universities and in general they kicked up a storm of adverse comment, because of their alleged unfairness. These questions to those familiar with them, and most readers of the daily press are, combined matters of history, general information and technical subjects and as a whole were a very fair test of a man's knowledge of a general character. To men of fair education, some years of experience and a good memory they were not very difficult: to young college or high school graduates, without much experience they appeared most difficult, and it is not at all strange that many such could not pass the test.

Let us suppose that Mr. Edison was of as much importance in the shipping world as he is in the electrical, and that he wished to employ some marine engineers. He would probably then subject the applicants to such a test as given in the following questions.

Many readers of his test questions gave themselves a conscientious self-examination, and assigned appropriate marks for each answer they could, offhand, give to the questions. So, my brother marine engineers, here is a chance for you to do likewise, and I hope some of you will send in the standing which you will assign to yourself in answering the following:

1. Who built the first triple-expansion engine in this country?
2. About what year was it installed and in what vessel?
3. Were marine boilers ever made of other material than iron or steel?
4. If so, what material or materials was used?
5. Name one large American passenger vessel which used a compound oscillating engine within the past thirty-five years.
6. What is the largest American passenger vessel?
7. What is the largest American freight vessel?
8. What is the largest horsepower used in any American-built vessel?
9. What is the largest side-wheel steamer now in use in this country?
10. Has any steamer ever been built in this country which used neither screw nor paddle wheels for propulsion?
11. If so, what method of propulsion was adopted?
12. Who invented the screw propeller?
13. What vessel was known while under construction as the "dynamite gunboat"?
14. What is the largest tugboat in the United States?
15. What is a hydrokineter and for what purpose is it used?
16. Why is bituminous coal used on steamships instead of anthracite?
17. What is cavitation and how is it caused?
18. How is the horsepower of a reduction geared turbine determined?
19. How is the horsepower of a Diesel engine ascertained?
20. What is $CO_2$?
21. What is the ideal percentage of $CO_2$ for efficient combustion?
22. What is "slip" and how is it determined?
23. What is forced lubrication, as applied to marine engines?
24. Does a triple expansion engine always have three cylinders?
25. How many barrels of ordinary fuel oil are equivalent in steaming value to a ton of ordinary bituminous coal?
26. What are the purposes of a deep tank on a freight vessel?
27. What is the mechanical equivalent of a heat unit?
28. What other material than wrought iron or wrought steel is sometimes used for anchor chains?
29. Who produced the first successful marine steam turbine?
30. How many cubic feet are there to a ton of bituminous coal?
31. What is the temperature of steam corresponding to a gage pressure of 200 pounds per square inch?
32. What is the generally adopted diameter of condenser tubes?
33. What type of condenser is almost universally used on Great Lakes steamers?
34. What is meant by a triple effect evaporator?
35. How would you determine whether or not distilled water contained salt?
36. What is meant by 28 inches of vacuum?
37. What is meant by 2½ inches of air pressure in a fireroom?
38. What is a single acting engine?
39. What is an average temperature at the bottom of the smoke stack?
40. Were geared marine engines ever used before 1900?
41. If so, wherein did they very materially differ from present types of geared turbines?
42. What was the name of the first steam vessel which crossed the Atlantic?
43. What firm, now in existence, built the original *Monitor?*
44. Name an American educational institution entirely devoted to naval architecture and marine engineering.
45. Who is the present head of the Steamboat Inspection Service and what is his official title?
46. Name three well known manufacturers of marine pumps.
47. What is a pneumercator, and what is its purpose?
48. How many members are there to the Shipping Board?
49. What is a red ink license, and why are they so called?
50. What department of the Government has jurisdiction over the Light House Service?
51. How much toll will have to be paid by a 5,000 net tonnage freighter going through the Panama Canal, loaded?
52. How are the living quarters on a motorship heated?
53. Is there any patent on a Diesel engine?
54. What is the origin of the term "starboard"?
55. For what is a clinometer used on shipboard?
56. State Simpson's rule.
57. What is a planimeter?
58. For what length of time is a marine engineer's license good?
59. What is the "deadweight" tonnage of a ship?
60. What materials should be used for suction pipes in bilges?



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61. What is the approximate area of smoke stack in proportion to the grate surface?
62. Why should the use of cylinder oil be restricted to a minimum?
63. From what is the term "monkey" wrench derived?
64. How many cubic inches are there in a gallon of oil?
65. Why should not alternating current be used for the propulsion motors in an electrically driven ship?
66. What is the average percentage of electrical loss between generator and motor in an electrically driven ship?
67. What is the proper proportions of glycerine and water in a hydraulic telemotor steering gear system? Why is glycerine used?
68. What is a fair steam consumption per horsepower for a turbine reduction main drive?
69. What material is mostly used to line stern bearings?
70. Name four of the principal American manufacturers of turbine reduction marine engines.
71. Who was the inventor of the most generally used bilge suction strainer?
72. What is the principle on which an ordinary pyrometer works?
73. What is the correct position to place a draft gage in a forced draft system?
74. What should be the maximum chlorine contents of feed water for watertube boilers?
75. The same for Scotch boilers?
76. How should a steam deck winch be safeguarded in freezing weather?
77. Name three principal causes of excessive sparking of brushes on a marine generator?
78. If three water gage glasses on a marine boiler should break within an hour, what would you think caused it?
79. Why is zinc used in a boiler?
80. When should zinc plates be used around the stern post and rudder post?
81. Why are load lines fixed for sea-going vessels?
82. What elements should be considered in certifying to the amount of fuel oil received, if the contract is by the barrel, and payments are to be made by the ton?
83. What causes spontaneous combustion in a ship's bunkers?
84. What materials are generally used to filter feed water for marine boilers?
85. What precautions should be taken before sending a man into a tank which has contained fuel oil?
86. What superiority has a Diesel engine over a steam engine for marine propulsion?
87. Wherein does a steam siren differ from an ordinary whistle?
88. What is cop waste?
89. What treatment is best for bad steam burns?
90. What is meant by a "feathering" paddle wheel?
91. How are steam gages tested for accuracy?
92. What is the difference between a tube and a pipe?
93. What is a dynamometer?
94. Will a gasoline engine work in a motor boat without a clutch?
95. For what purpose is a devil's claw used on board ship?
96. Who is the president of the American Society of Naval Architects and Marine Engineers?
97. Name three prominent marine papers published in the United States.
98. What is the leading treatise on marine engineering published in America?
99. What is a Naperian logarithm?
100. Give ten good reasons why marine engineers have to know more than locomotive engineers. Name one hundred if you like.

Now, after you have read over the foregoing I can hear you say "What's the matter with this old guy, anyhow, to ask such foolish questions?" or perhaps it will be "Any fool can ask questions which ten wise men cannot answer." All right, I'll admit it, and perhaps I cannot answer them all myself, but just the same they will give you a very good test, as there are no catch questions among them. If you can, with a clear conscience, give yourself a rating of 70 percent, "I'll tell the world" that you are an up-to-date marine engineer, and will recommend you to Edison for a job—that is, if he goes into the steamship business.

## Reorganization of the Shipping Board

(*Concluded from page* 580)

When the new administration took command at the Shipping Board there were three or four boats out on the bare boat charter plan. However, the disposition under the old regime was to proceed cautiously in this direction on the theory that the bare boat charter plan, in its present shape, does not offer a solution for the problems of the Shipping Board. Nevertheless, it is conceded by the minor officials in the Shipping Board who have been closest to the operation of the bare boat charter system that the prevailing system has revealed grave defects or shortcomings.

### Bare Boat Charter Plan

It is admitted, for example, that there is some justification for the criticism by practical shipping men who have charged that the Shipping Board has, under its allocation program, indulged in a wasteful duplication of service to certain ports and that trade routes have been established which cannot be operated save at a loss. The retort at the division of operations has been that the Shipping Board has striven consistently to eliminate the services which have proved to be unprofitable.

That the Shipping Board's vessels have been unnecessarily competing among themselves is due, so the officials contend, to the agreement that became effective March 1, 1920, which permitted the managing agents considerable latitude in the handling of ships. The consequence of this granting of a free hand in operation was that there was concentration in the quarters where cargo appeared to be available and the outcome was the overtonnaging of certain berths. When the new management took hold, the division of operations was in the midst of an effort to correct this operation at cross purposes by eliminating a certain proportion of the managing agents and so combining services as to bring about co-operation instead of competition. This snuggling up process has already been inaugurated in the South Atlantic and the revision of North Atlantic schedules is under way. The whole tendency in the division of operations in recent months has been to cut down the number of trade routes rather than to increase the total, albeit a few additions have been made. The policy of gradual elimination has been based on the belief that the war created a heavy movement of tonnage on trade routes which could not be permanent.

It is a foregone conclusion that the reorganized Board, with its determination to take the Shipping Board out of the shipping business as promptly as may be, will conform to the policy heretofore in force which contemplates the winding up of the shipbuilding program not later than April, 1922. There has, however, been suggestion in Congress that the Shipping Board ought to shut down tight on its building operations in all yards for an interval of say six or eight months. The loss that would be entailed by such interruption, not to mention the injustice to shipbuilders, has prevented the proposal receiving serious consideration. Whatever experimentation may be necessary, ere the reorganized Board "finds itself" the expressed determination of its chairman is to justify the belief of President Harding that it is possible to place a permanent American merchant marine on a paying basis.

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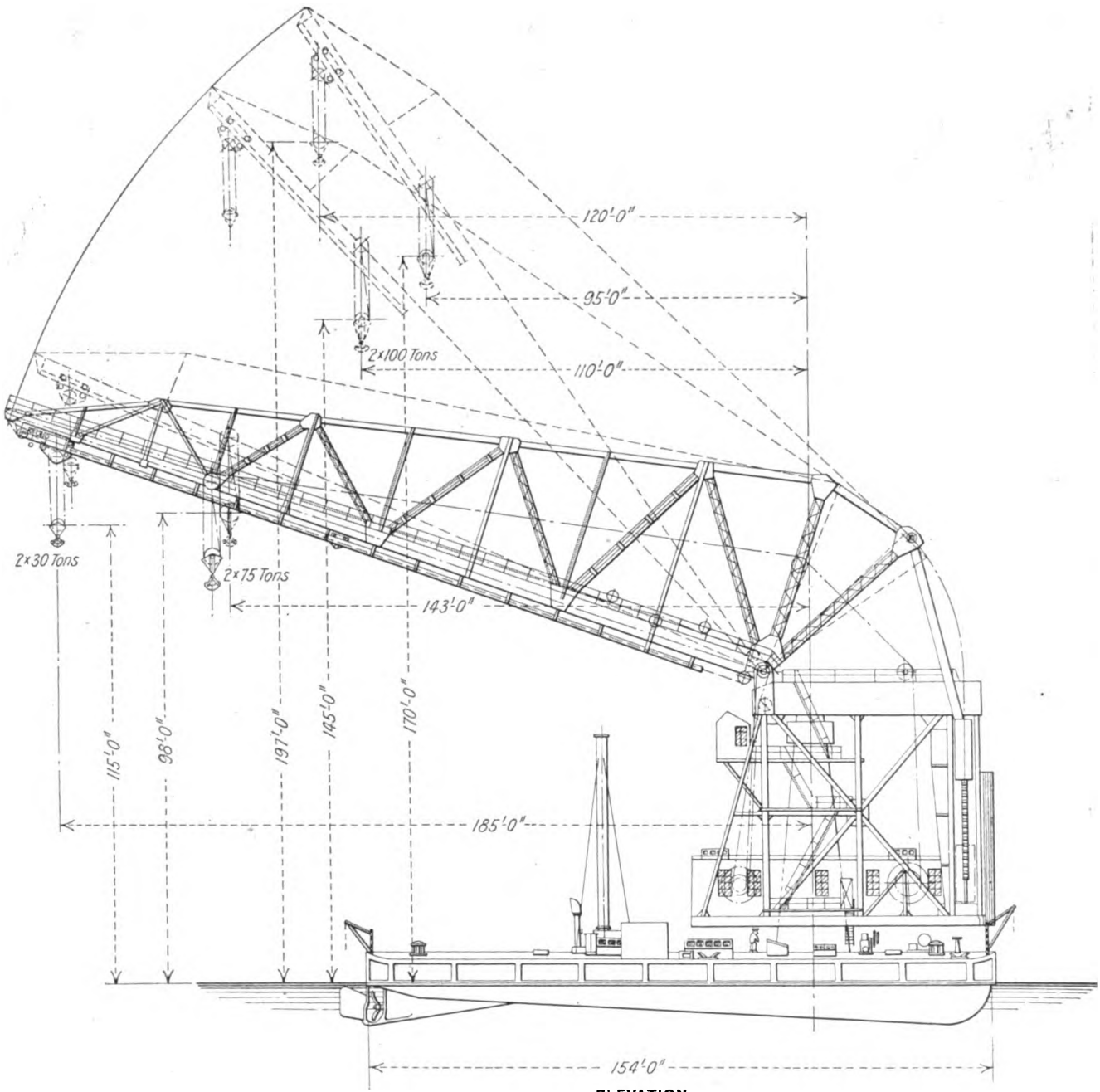
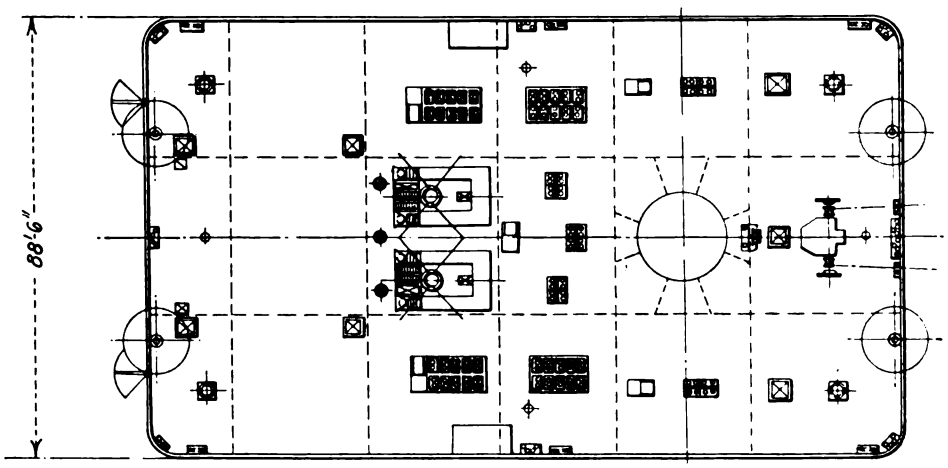



ELEVATION




PLAN

**Fig. 1.—200-Ton Floating Crane Mammouth**

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# Derricking Jib Type Floating Crane Mammouth

## 200-Ton Floating Crane Acquired by the Mersey Docks and Harbor Board for Service in the Port of Liverpool

IN order to meet the increased demand in the port of Liverpool for a high capacity crane for dealing with heavy loads, the Mersey Docks and Harbor Board has acquired a floating crane capable of handling loads up to 200 tons. This crane, named the *Mammoth,* is of the derricking jib type and was built by the Werf Gusto, Firma A. F. Smulders, Schiedam, Holland. The arrangement is such as to permit the handling of heavy loads over the gates of large graving docks, an asset of great value to the ship repair business.

### Pontoon and Crane Structure

The crane structure is mounted on a self-propelled pontoon, 154 feet in length and 88 feet 6 inches beam. The crane is carried on a tower about 66 feet high, built in the form of a truncated cone and strongly secured to the deck, sides and bottom of the pontoon.

There are two principal parts to the crane, these being the framework and the jib. The framework may be divided into the upper platform, which rests on the top bearing, a lower platform in which the center rollers of the tower are placed and the connecting structure between. The jib is connected to the framework by two pins at the front of the upper platform and by two links to a movable counterweight located between the platforms at the back. Vertical guides are provided and the counterweight is operated between these by vertical worm shafts, the raising and lowering of the jib being accomplished in this manner. Behind the crane framework and cabin is another counterweight for further balancing the crane.

### Capacity

The scope of action and lifting capacities of the crane are shown in the following table:

| Load, Tons | Radius, Feet | Clear Overside and Overstem Distance, Feet | Height of Blocks Above Water, Feet | Speed of Lift, Feet Per Minute | Remarks |
|---|---|---|---|---|---|
| 200 | 110 Max.<br>95 Min. | 65¾ Max.<br>50¾ Min. | 145<br>170 | 3½<br>3½ | Loads handled by blocks fixed on crane jib. |
| 150 and less to 60 | 143 Max.<br>95 Min. | 98¾ Max<br>50¾ Min. | 98<br>170 | 3½<br>3½ | |
| 60 and less | 185 Max.<br>120 Min. | 140¾ Max.<br>75¾ Min. | 115<br>197 | 16½<br>16½ | Loads can be handled by trolleys along the full length of the jib, at a speed of 12 feet per minute to a minimum radius of about 30 feet. |

The crane is designed so that the loads can be revolved through a complete circle without the adding or removing of any special counterweight.

### Operator's Cabin

A cabin is built at the top of the framework just below the jib hinge pins and from this point the various movements of the crane are controlled. Only one man is required in the control cabin even when handling the heaviest loads and he has a clear view of the load and the deck of the pontoon, being thus able to observe all movements of the weight he is dealing with.

The simplicity in handling is accomplished by connecting up the electrical installation in accordance with the Ward-Leonard system. This system enables any load to be hoisted or lowered at extremely low speeds, a feature of great importance when handling heavy weights, erecting, etc., and also permits any weight to be moved at varying speeds without any change being made in the mechanical transmission. Other advantages of the Ward-Leonard system are that only weak currents are controlled, thus reducing the wear and tear of contacts to a minimum and practically eliminating loss of energy. The starting of the motors is accomplished without placing any undue stresses on the crane structure or the transmission gear and owing to the small number of controllers, switches, etc., the maintenance charges are low.

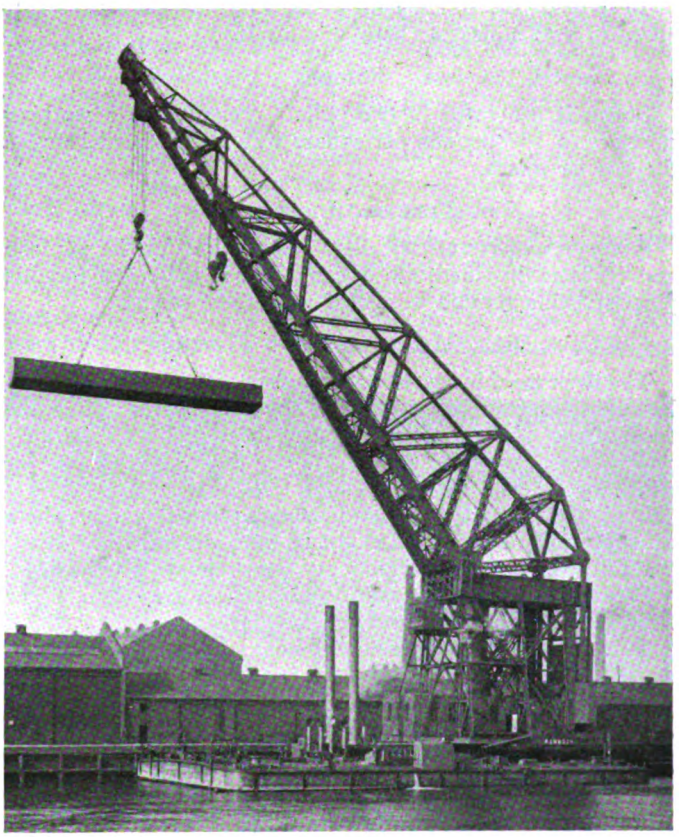

**Fig. 2.—Floating Crane Mammouth in Action**

### Winch Room

A winch room about 65 feet by 23 feet is located on the lower platform and in this room is located the machinery for operating the crane.

All the movements are effected by electric motors of which there are ten in all. The power is transmitted from the motors by worm gearing and gear wheels and electrical brakes are fitted to all motor shafts.

### Generating Plant

The current for operating the electric motors is supplied by dynamos driven by one of the triple expansion steam propelling engines which, with their switchboards, are located below decks in the pontoon.

Electric cables convey the current from the dynamos to the interior of crane tower. The cables are connected to slip rings on the outside of the upper end of the tower and from these slip rings the current is collected by brushes and dis-



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tributed to the various motors in the winch room and to the control cabin.

Wherever possible, safety devices have been fitted such as switches for limiting the working range of each movement and the speed of trolleys, emergency switches, electrical brakes and automatic cut outs for guarding against too heavy currents.

### PROPELLING MACHINERY

Twin screws are provided to propel the pontoon, the engines being of the triple expansion marine type working at a steam pressure of 150 pounds per square inch.

One of the engines is arranged so that it may be uncoupled from the propeller shaft and used to drive the generating plant used for supplying current for operating the crane.

In a trial trip conducted on the River Meuse an average speed of 4.85 miles per hour was attained.

### BOILERS

Steam is generated in two boilers designed for a working pressure of 147 pounds per square inch and located between the engine rooms.

### ELECTRIC LIGHTING

A very extensive electric light installation for the pontoon and crane is provided, the dynamo and switchboard for this purpose being located in one of the engine rooms.

### DECK MACHINERY AND FITTINGS

The deck machinery is very complete and includes a windlass, four capstans operated by engines located below the deck of the pontoon, steam steering gear, bollards, etc.

### ACCOMMODATIONS

Only three men are required for operating the crane, these being an engine-driver, deck hand and crane-driver.

Cabins, galley and lavatory for the crew are provided.

Provision for a lamp room, coal bunker, storeroom, water tank, etc., is also made.

The crane was towed from Schiedam to Liverpool without the jib being dismantled.

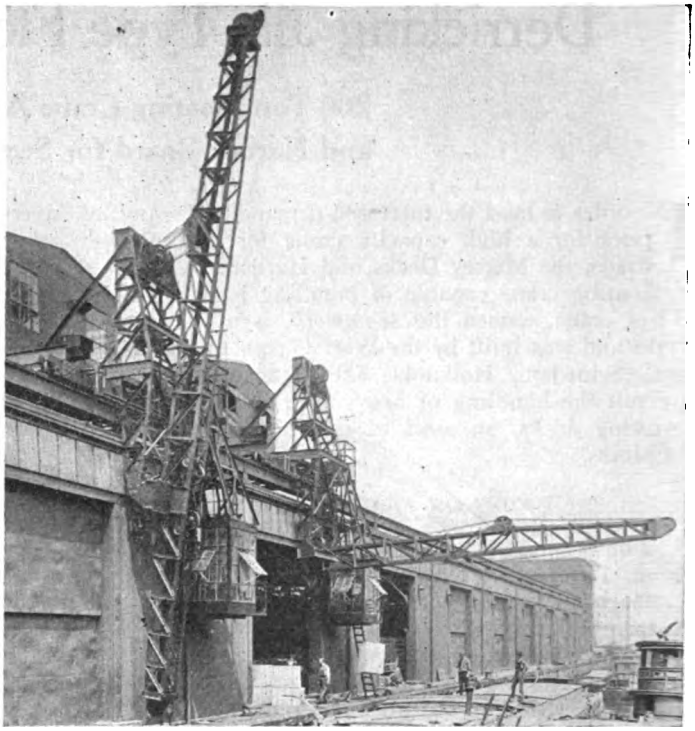
---

## Time and Labor Saved in Handling Freight at New York Barge Terminal by Installation of Modern Crane Equipment

**By Henry Cunningham, Jr.**

UNTIL recently freight handling methods on Pier 6, East River, New York, the terminal of the New York State Barge Canal, were rather antiquated, consisting principally of a whip boom, block and tackle and a horse for motive power. The operation of raising the load from the hold of a barge consisted in walking the horse, which was at the end of the lift line, along a drive until the load reached a sufficient height, when the whip boom was swung around by hand and the load deposited on the apron of the pier. From here it was moved by hand under the pier shed. The inefficiency of this system, and the delays caused by it, made necessary the installation of modern equipment.

The new installation includes two Shaw wharf cranes. manufactured by Manning, Maxwell and Moore, Inc., New York City. These cranes are of the overhead type, traveling on two tracks, one carried over the front row of the building columns and the other 10 feet back over the roof of the pier. Each boom, which has an outboard reach of 32 feet 6 inches and an inboard reach of 10 feet, is pivoted to the traveling frame. The capacity of each crane is 3,000 pounds with the boom horizontal or at any angle up to 45 degrees and with the trolley in any position on the boom.



**3,000-Pound Shaw Wharf Cranes Installed at Pier 6, East River, New York**

As indicated, the cranes travel on tracks above the pier shed roof, and therefore do not obstruct the apron of the pier. While traveling, the boom is nearly vertical, in which position ample clearance is allowed between the pier shed and the ship's rigging. When the location for action is reached the boom of the crane is lowered, the outboard end being over the hatch of the vessel and the inboard reaching inside the pier shed. Packages from the barge or vessel may be hoisted from the hold and deposited inside the pier shed, thus relieving congestion due to hand distribution. By utilizing simultaneously the hook hoist and trolley movements the load may be carried in a diagonal line from loading to unloading points.

The cranes are equipped with type "Z" Shaw motors, operating on 220-volt direct current. The hook hoists and rack motors are of 18 horsepower, compound wound, and the boom and travel motors 8 horsepower series wound. All motors are equipped with a series wound solenoid operated band brake. The controllers are of the drum type with vertical handles.

The hook hoist and rack have a speed of 125 feet per minute with the full load, and 200 feet per minute with no load. The boom may be hoisted from the horizontal to the vertical position in one minute. The traveling speed is 100 feet per minute. The hook hoist, trolley rack and boom hoist machinery are located on the crane frame, well to the rear, where they act as a counterweight, thus giving stability to the crane. The operator's cage is suspended from the crane frame at one side of the boom at a sufficient height to give the operator a clear view of the load.

With the former method of freight handling at Pier 6 it took eight men with the whip boom, block and tackle and horse equipment four days to unload 175 tons of freight. With one crane and two men in the hold of the barge, 175 tons of miscellaneous freight have been unloaded in an eight-hour day with the new equipment. As this record was made while the cranes were new and the operators somewhat slow in having the freight in the slings ready to be hoisted, the style of operations still offers an opportunity for further savings in time of loading and unloading barges.

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# Electrically Propelled Freighter Biyo Maru

## Japan's First Merchant Vessel Equipped with Electric Drive an 8800 Deadweight Ton Freighter

By C. Ano*

TOYO KISEN KAISHA, under the presidency of Mr. Soichiro Asano, one of the most progressive and energetic business men of the Far East, has always been keen on improving the economy of their ships along highly technical lines. They have been the first steamship owners in that country to own and operate an ocean going turbine steamer and also a geared turbine steamer (*Tenyo Maru* in 1908 and *Anyo Maru* in 1912, respectively) and probably the first steamship owners in the world to make practical use of mineral oil for the fuel of ocean going steamers. Now they are to have the honor of being the owners of the first electrically propelled merchant vessel in Japan.

### Principal Dimensions

| | |
|---|---|
| Length between perpendiculars..... | 400 feet 0 inches |
| Breadth molded ..... | 53 feet 0 inches |
| Depth molded ..... | 32 feet 0 inches |
| Tween deck height..... | 10 feet 0 inches |
| Gross tonnage ..... | 5,479 tons |
| Load draft ..... | 25 feet 9 inches |
| Deadweight carrying capacity..... | 8,800 tons |
| Designed speed at sea..... | 11 knots |

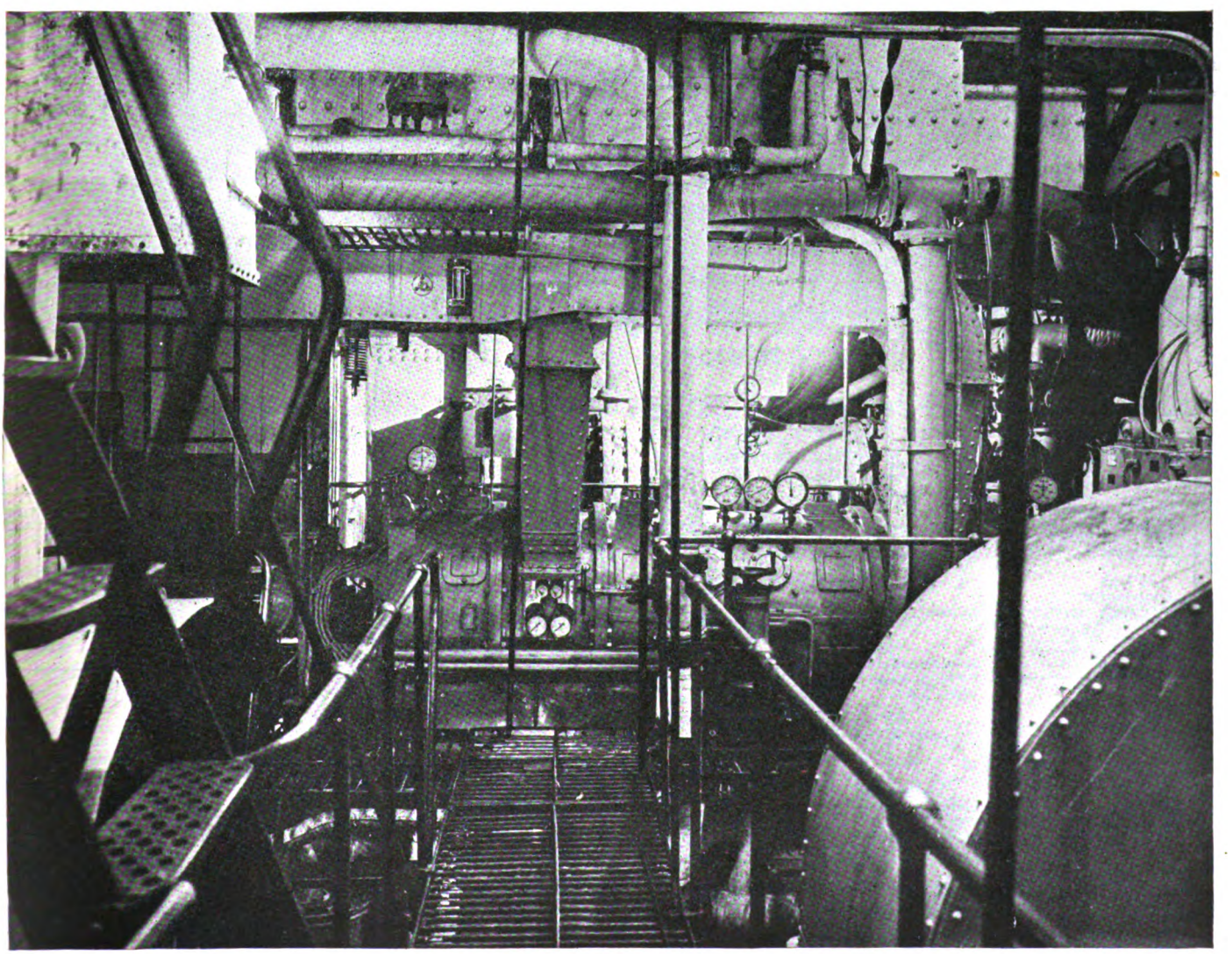
*Director and chief draftsman, Asano Shipbuilding Company.

### Propelling Machinery

The propelling machinery is located amidships and its main parts consist of two sets of Ljungstrom turbines, each driving two electric generators and two induction motors which drive the propeller shaft through a helical toothed single reduction gear, all manufactured by the Svenska Turbinfabriks Aktibolaget Ljungstrom, Finspong, Sweden.

The turbines are the radial flow double rotation type and are designed to work with steam at a pressure of 225 pounds per square inch and superheated up to 650 degrees F. at the inlet valve and to discharge into a vacuum of 29 inches. Each turbine has two sets of blading turning in opposite directions coupled to two three phase alternating current generators of the revolving field and self exciting type.

Each generator is designed to run at 3,600 revolutions per minute and to give a three phase alternating current of 1,000 volts at 60 cycles. Each turbine, with the generator coupled



**Engine Room of S. S. Biyo Maru, Showing Starboard Turbine and Generator**



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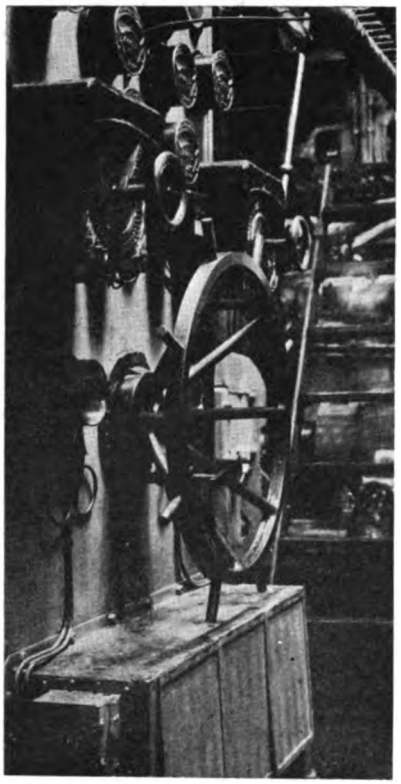
on, is mounted on a surface condenser, which rests on a strong steel plate girder foundation.

Each of the induction motors is to develop 1,360 horsepower with the current of 1,000 volts and 60 cycles and at the normal speed of 600 revolutions per minute.

### REDUCTION GEARING

The reduction gearing consists of a large helical toothed spur wheel and two pinions, each of which is coupled to one of the induction motors. The ratio of reduction is about 7.5, the normal rate of revolution of the propeller shaft being 80 per minute which corresponds to a speed of about 11 knots when the ship is fully loaded.



**Maneuvering Gear**

The main maneuvering gear is in a rectangular pillar stand containing switches, electro meters and the liquid type resistances, and is worked with a large hand wheel in the front.

### ELECTRICALLY DRIVEN AUXILIARIES

The auxiliary machinery, used in conjunction with the main machinery, is electrically driven, each unit being fitted with a separate induction motor taking current from the main generators. It consists of:

2 sets of air pumps, fitted with cylindrical tanks and working on the kinetic system.
2 sets of circulating pumps, of centrifugal type.
2 sets of main feed pumps, of centrifugal type.

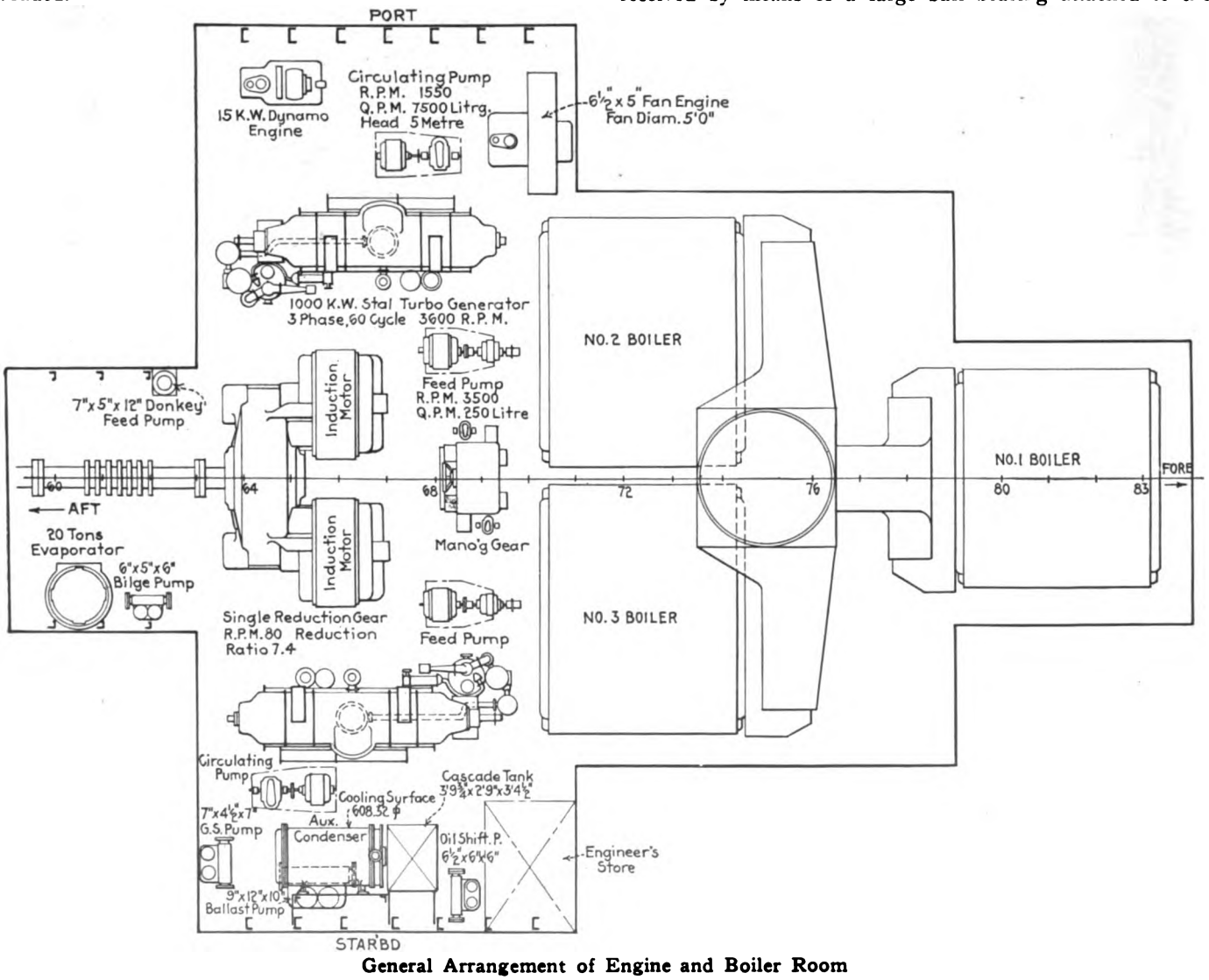
Other auxiliary machinery in the engine and boiler rooms are steam driven and include the following:

| | |
|---|---|
| Donkey feed pump: one simplex double acting | 7x5x12 |
| General service pump: one duplex double acting | 7x4½x7 |
| Ballast pump: one duplex double acting | 9x12x10 |
| Bilge pump: one duplex double acting | 6x5x6 |
| Fuel oil shift pump: one duplex double acting | 6½x6x6 |
| Fan engine for harbor use | 6½x5 |

Besides these, there is an ash hoisting engine, evaporator, auxiliary condenser, feed water heater, feed water filter, two fuel oil pumps and a small fuel oil gravity tank.

### PROPELLER

The propeller is 17 feet 9 inches in diameter with blades set at a pitch of 16 feet 1½ inches. The blades, which are four in number, are made of manganese bronze and are attached to a cast iron hub. The thrust of the propeller is received by means of a large ball bearing attached to the




**General Arrangement of Engine and Boiler Room**

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forward end of the gear wheel shaft in addition to an ordinary horseshoe type thrust bearing.

### BOILERS

Steam is supplied by three single ended Scotch boilers, two of them being 14 feet 3 inches in diameter and 11 feet 6 inches long, having three corrugated furnaces, and one 12 feet 6 inches in length, having two corrugated furnaces. The boilers are designed for a working pressure of 225 pounds per square inch by gage and to burn either coal or oil alone or coal and oil mixed. Howden's system of forced draft is adopted. Air trunks are led from the generators so that the air for cooling them is utilized. The fan engine mentioned above is to be used only when the generators are not working.

The ship is lighted throughout by electricity and for this purpose there is a set of motor generators taking the current from the main generators and from a steam driven generator when in a harbor.

After the ship was launched several changes were made in the minor parts of the machinery as a result of the experience gained by the engineers who were attending to the fitting out work and installation. She went on the trial trips early in May, 1921, the results of which were very satisfactory. She is expected to run very easily at over 11 knots when fully loaded, with far less consumption of fuel than her sisters equipped with reciprocating engines, and at the same time gaining considerably greater cubic and deadweight capacities of general cargo.

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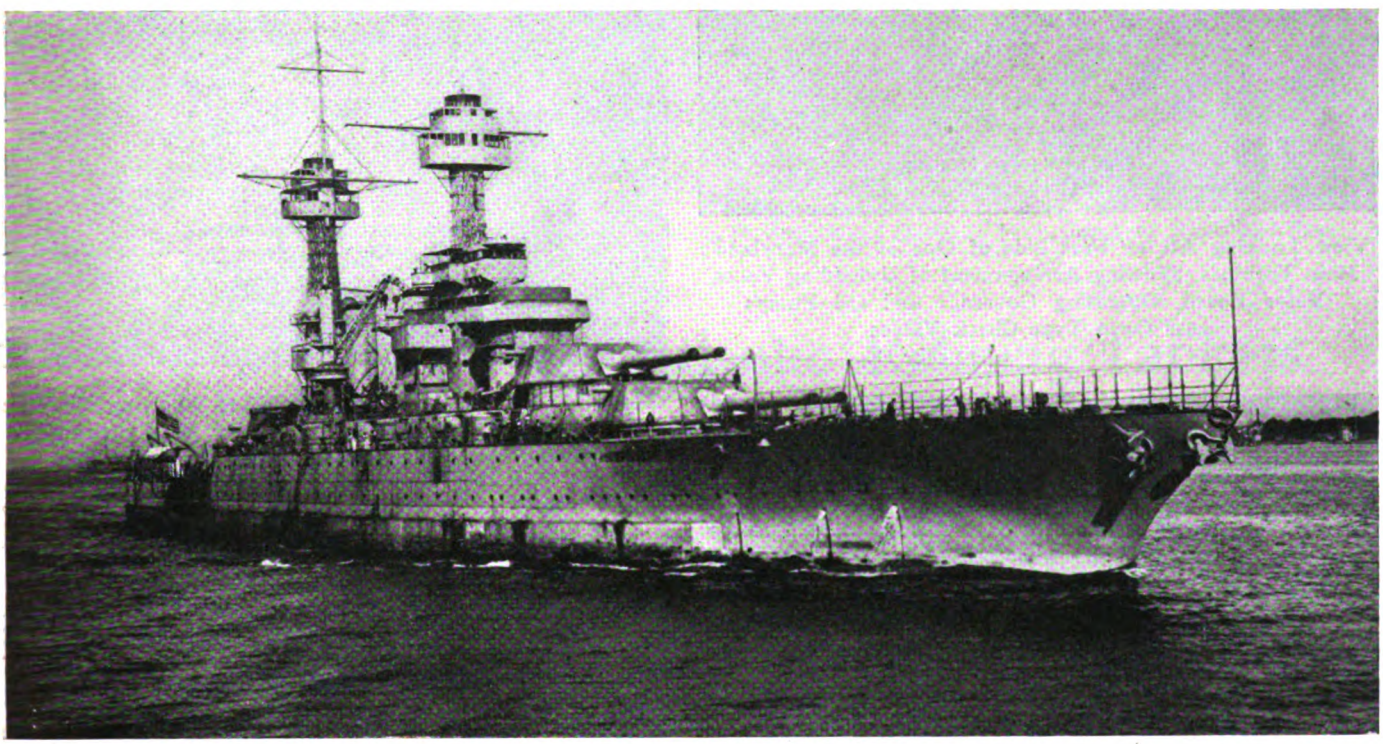
MANAGEMENT ENGINEERING is the title of a new monthly publication issued by the Ronald Press, New York. Its contents are devoted to a discussion of problems of management and production, the object, as stated in the first issue, being "to help executives better to discharge their duties in preparing, organizing and directing industry to secure maximum production." L. P. Alford is editor of the magazine and E. W. Tree, associate editor. Mr. Alford was formerly editor of the *American Machinist* and later of *Industrial Management*. He is a vice-president of the American Society of Mechanical Engineers.

## Battleship Maryland to Be the Most Powerful Fighting Craft in the World

WHEN the United States battleship *Maryland* steams out of Hampton Roads early in November for her official trials, she will be the most powerful fighting vessel in the world as she will carry in four turrets of two guns each eight 16-inch guns, the largest ever mounted in a battleship. These guns are about 57 feet in length and fire a shell weighing 2,100 pounds for a distance of more than 20 miles.

Displacing 32,600 tons, the *Maryland*, electrically driven, will have a speed of 21 knots and a cruising radius of 10,000 miles. She will burn oil, her fuel capacity being approximately 1,392,200 gallons. She is the third in the order of completion of the electrically propelled battleships for the Navy. She was built by the Newport News Shipbuilding and Dry Dock Company, Newport News, Va., and the electrical equipment was designed and manufactured by the General Electric Company, Schenectady, N. Y. The ship was launched on March 20, 1921, and has the following main characteristics:



**United States Battleship Maryland**

| | |
|---|---|
| Length | 624 feet 0 inches |
| Beam | 97 feet 6 inches |
| Draft | 30 feet 6 inches |
| Displacement | 32,600 tons |
| Speed | 21 knots |
| Number of propellers | 4 |
| Shaft horsepower | 28,000 |
| Oil capacity | 1,392,200 gallons |
| Oil burning boilers | 8 |
| Officers | 67 |
| Crew | 1,400 |
| Main battery | Eight 16-inch guns |
| Secondary battery | Fourteen 5-inch guns |

Like her prototype, the *New Mexico*, pioneer electric warship of the world, the *Maryland* is electrical throughout. Her main propelling machinery consists of two Curtis steam turbine generators, each designed to develop 11,000 kilowatts at a speed of 2,030 revolutions per minute to drive the ship 21 knots. These supply power to four 7,000 horsepower Gen-

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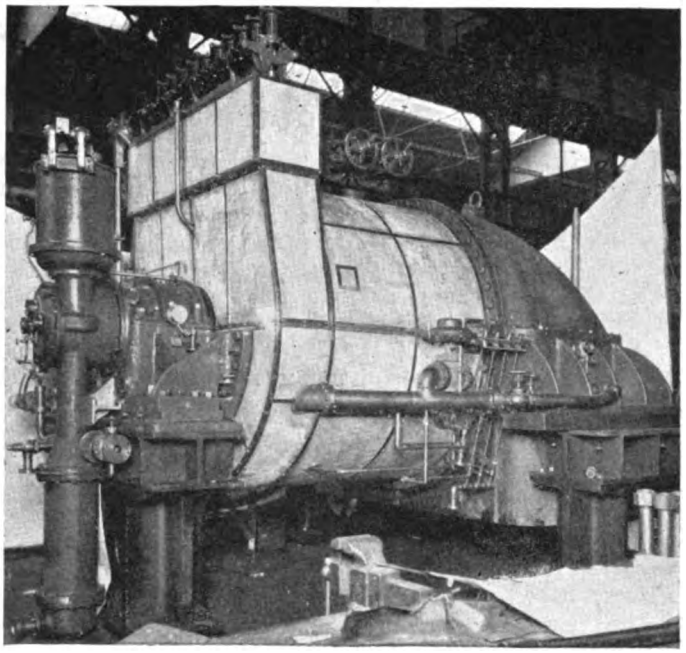
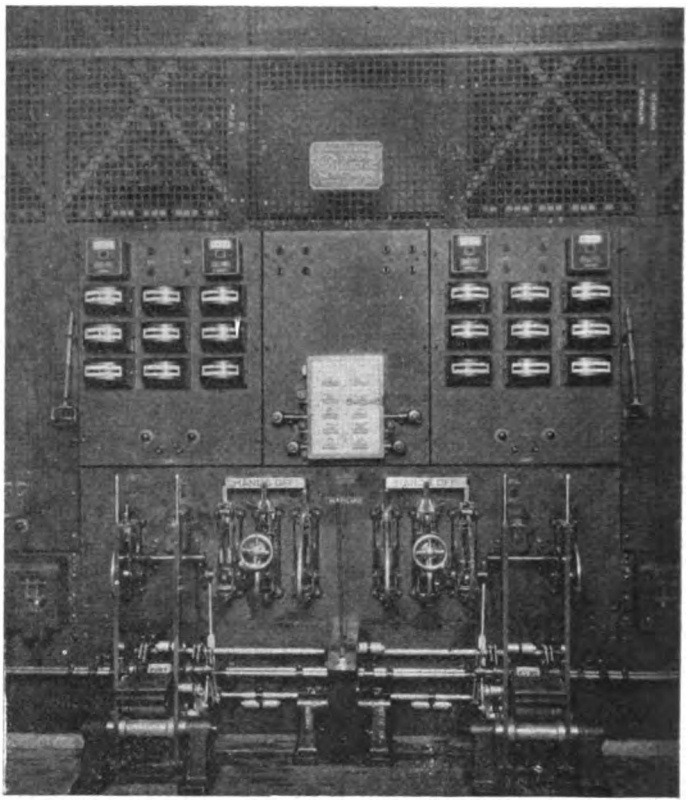
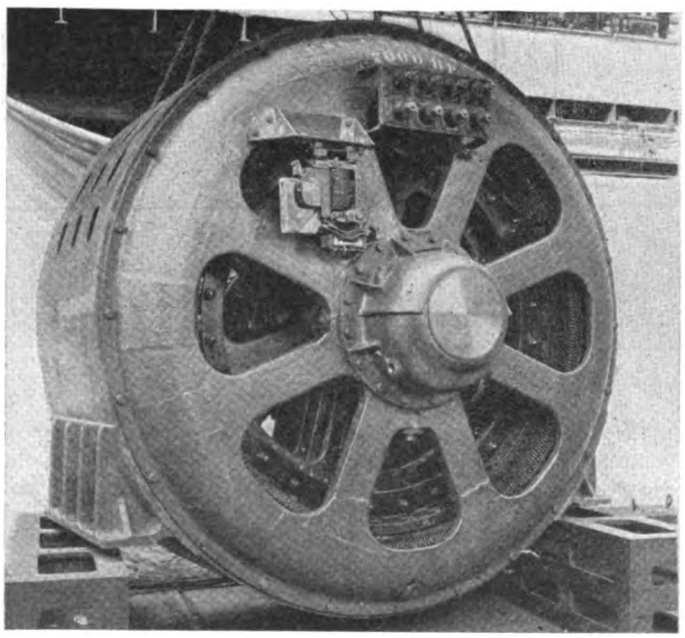


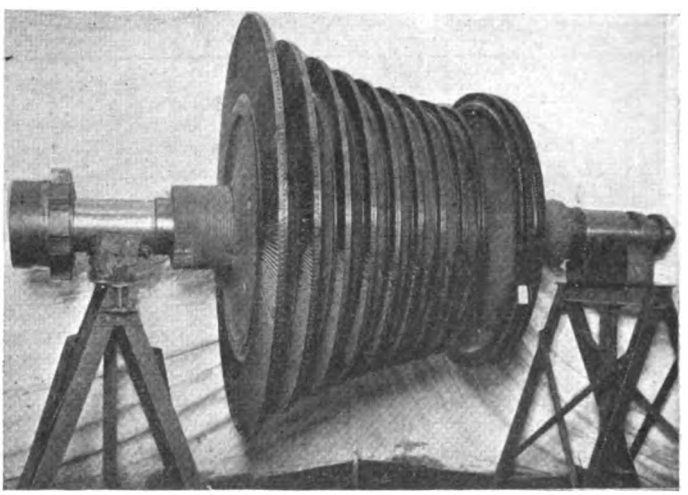
View Looking Aft on Port Side of One of the Maryland's Main Turbines, Showing Arrangement of Unloading Valve, Valve Board, Operating Governor and Oil Pumps and Open Type Check Valves



Control Equipment of U. S. S. Maryland, Showing Electrical Instruments and Operating Levers for Field Steam Reversing, Pole Changing, Field Selective Bus Tie and Emergency Trip



Coupling End of 7,000 Horsepower Propelling Motor with End Shield Screens Removed



Assembled Turbine Rotor of One of the Maryland's Main Propelling Units

eral Electric induction motors, directly connected with the four propellers and turning at 170 revolutions per minute. The motors, among the largest ever built, are 12 feet in diameter, weigh 62 tons, and the 28,000 horsepower thus available for propulsion purposes is enough to supply power to a city of 100,000 population.

The two turbine generators, supplied with steam generated by eight oil burning boilers, can be run independently. Either is capable of driving the ship up to a speed of about 17 knots. The power generated by them is used for no other purpose than propelling the ship, electrical current for other needs being generated by six 300 kilowatt turbine generators. The electrical equipment includes radio telegraph, loud speaking telephones, ordinary telephones, gyroscopic compass, steering gear, anchor windlass, capstan, boat cranes, winches, air compressors, air heaters, turret training, turret gun elevating, ammunition hoists, gun firing, range signalling, powder testing oven, common deck fans, ice machines, laundry equipment, carpenter shop, lighting, visual signals, motion pictures, sterilizer in operating room, potato peeler, ice cream freezer and other kitchen utensils, bake ovens, irons for laundry and tailor, storage batteries, motor boat ignition, etc.

Four more battleships of this type are being built, the *California*, to be completed this summer; the *West Virginia*, to be ready for her trial trips in 1922; the *Colorado* and the *Washington*. In addition the Navy is building six 43,000 ton, 60,000 horsepower battleships and six battle cruisers, rated at 180,000 horsepower each.

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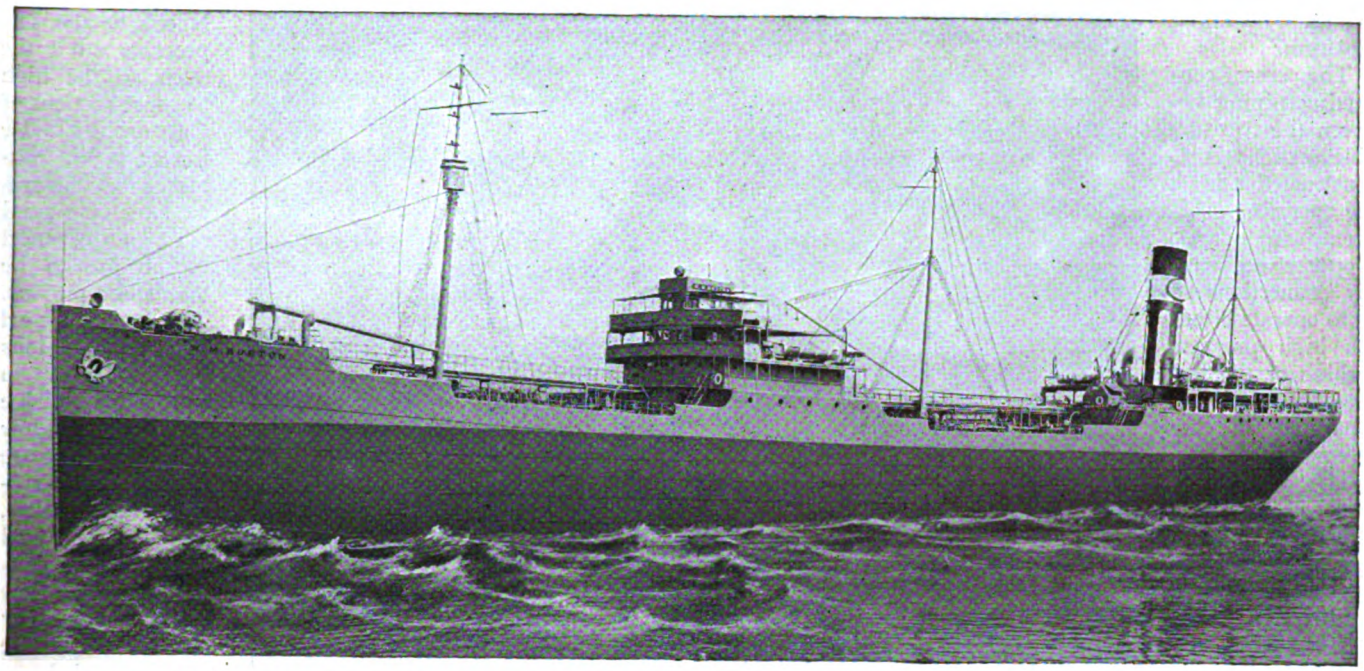

10,500-Ton Tanker W. M. Burton: Length 735 Feet, Beam 56 Feet, Mean Draft 27 Feet, Depth of Hold, 33.6 Feet

# New Machinery for Atlantic Refining Tankers

## 10,500-Ton Tank Steamers Refitted With De Laval Double Reduction Gears and Turbines

FIVE 10,500-ton tankers, the *W. M. Burton, Herbert L. Pratt, J. E. O'Neil, W. M. Irish* and *H. C. Folger,* which were built for the Atlantic Refining Company in 1917 and 1918 by the Union Plant (San Francisco) of the Bethlehem Shipbuilding Corporation, Ltd., are being fitted with new propelling machinery consisting in each case of a set of De Laval cross compound turbines of the impulse type divided into high pressure and low pressure sections and connected to a single propeller through a set of double reduction one-plane speed reduction gears. The original geared turbine machinery installed in these vessels was rated at 2,600 horsepower.

In making the change, the Atlantic Refining Company decided to increase the horsepower in order to obtain higher speed from the tankers. The new propelling units, therefore, are rated at 3,300 horsepower each and are designed to give the vessels, which are 435 feet long, 56 feet beam and 33.6 feet depth of hold, a speed of 11 knots on a 27-foot mean draft.

Each turbine delivers its full power at a speed of 3,300 revolutions per minute on both the high and low pressure elements. The reduction of this speed of the turbines to the 90 revolutions per minute of the propeller is accomplished in two steps, making the total reduction ratio 35.5 to 1. The direction of rotation of the slow speed gear shaft is clockwise when viewed from the after end.

### The Turbines

The high and low pressure turbine elements are so arranged that they can be operated independently of each other in case of emergency by means of a flexible throttle control. Both high pressure and low pressure turbine rotors are connected to separate pinions. The high pressure turbine element for ahead operation is equipped with one velocity stage and seven pressure stages. The low pressure element for ahead operation consists of six pressure stages. One reversing element is located in the high pressure turbine which operates in series with a reversing element located in the low pressure turbine.

Full power is developed at a steam pressure of 200 pounds gage with a superheat of 50 degrees F. and a vacuum of 28 inches. Each turbine section develops one-half of the full rated power for running ahead. The astern power developed is two-thirds of the full ahead torque.

### Operation

Steam is admitted through a strainer to a valve under control of speed governors located on the forward end of both high and low pressure turbines. These governors are set to bring the governor valve into operation when the speed reaches 10 percent above normal. When brought into operation this governor does not entirely cut off steam, as an emergency trip would do, but holds the speed below a safe limit without shutting down the unit.

From the governor valve steam passes into the ahead or astern nozzle of the high pressure section, passes through the stages of this section and is returned through cross connecting piping to either the ahead or astern nozzle chambers of the low pressure section, exhausting from there into the condenser.

The maneuvering valves are balanced vertical spindle valves and control the steam to the ahead and astern elements of the turbine. The valves are operated by hand wheels and are interlocked so that only one of the valves can be operated at a time. Hand valves for further controlling the steam supply to the first stage nozzle of the high pressure section when less than full speed is desired are installed.

Leakage through the throttle valve of steam to the astern element when driving ahead for considerable periods of time is prevented by a guarding valve which is operated from the



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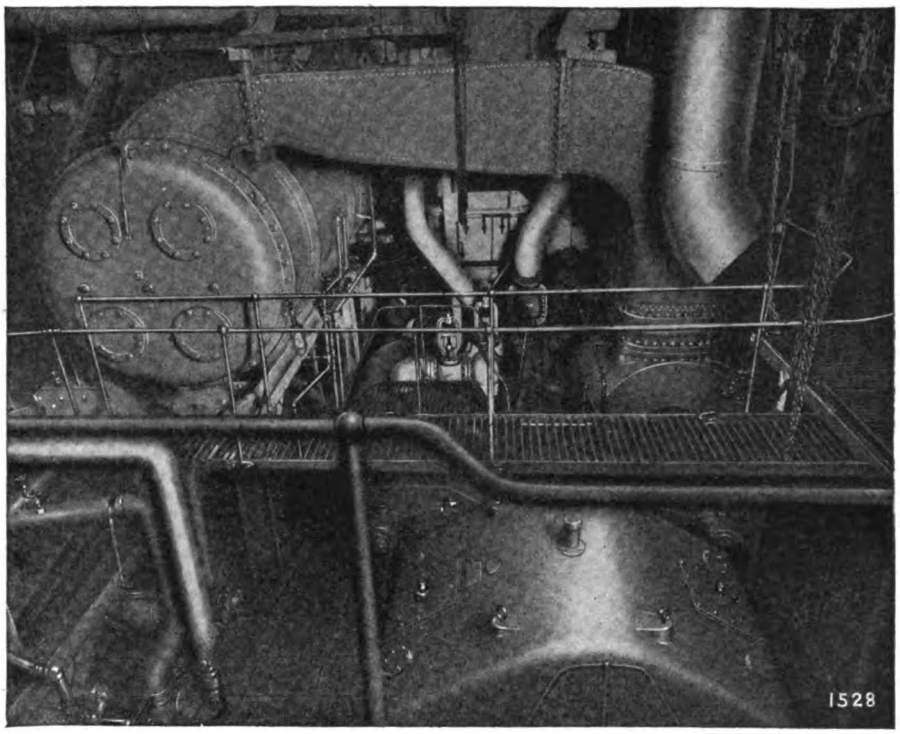
main operating platform.

The cross connecting piping between the two turbine sections is so constructed that the operating engineers can make proper steam supply connections so as to operate either the high pressure turbine or the low pressure turbine separately in case of emergency.

The turbine wheel case is supported in such manner that it is free to expand in all directions without changing the position of the axis, so that the centerline of the wheel case and the centerline of the shaft coincide under all conditions. It is therefore possible to start the turbine quickly and safely, without danger of rubbing, vibration or other troubles due to distortion by heat.



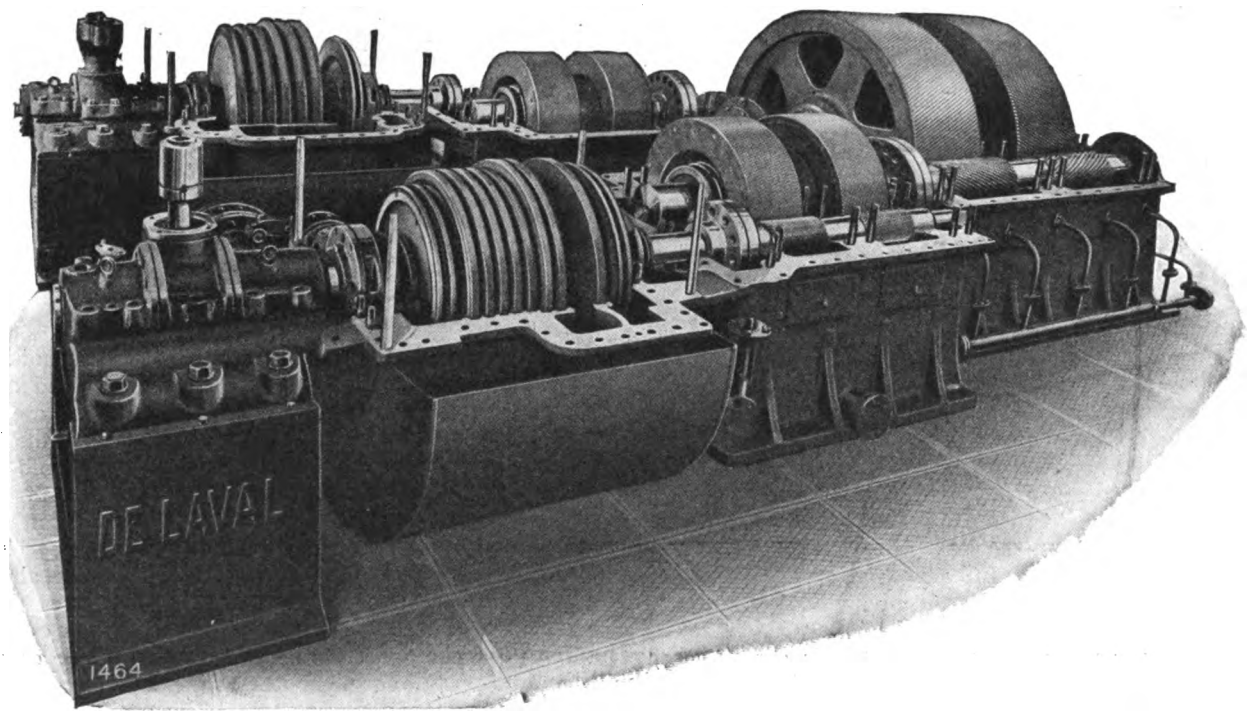

View Looking Forward from Above Propeller Shaft in Engine Room of S. S. W. M. Burton

Ample bucket clearances both axially and radially are provided so that the danger from internal rubbing is reduced to a minimum.

### The Reduction Gears

The speed reduction gears are mounted directly abaft the turbines and are divided into two elements, the high speed element and the low speed element. The high speed reduction consists of two parts in two separate casings, one of which is bolted to the low pressure and the other to the high pressure sections of the turbines. De Laval pin couplings which provide for free axial motion connect the turbines to the high speed pinions. The low speed gear with pinions is contained in one casing. The high speed and low speed gear cases are entirely independent of each other, the high speed gears being connected to the low speed pinions by means of a De Laval rubber bushed flexible coupling which gives proper compensation for any slight inequalities of alinement which may develop in the operation of the gear.

Both high speed and low speed gears are designed for low tooth pressure and ample factors of safety. The pinions are made from nickel steel forgings and the gears consist of cast iron centers upon which are shrunk seamless rolled steel bands in which the gear teeth are cut.




De Laval 3,300-Horsepower Compound Double-Geared Marin Turbine; with Covers Removed to Show Turbine Rotors and Gears; Turbine Speed 3,200 Revolutions per Minute, Propeller Speed, 90 Revolutions per Minute

All parts entering into the construction of these propelling units are manufactured to limit gages and are interchangeable. This feature will appeal particularly to marine engineers. The operation of these propelling units was uniformly successful on the trial trip of the *W. M. Burton* and a speed

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One of the Floating Dry Docks at the Danziger Werft

of 11.77 knots was obtained. Since the trial trip, the *W. M. Burton* has been in continuous service and the propelling equipment has operated to the satisfaction of the owners.

On account of the anticipated low steam consumption the original condensing equipment which was installed in connection with the original 2,600 horsepower propelling units was not changed as the total steam consumption of the new units rated at 3,300 horsepower was not greatly in excess of the total steam consumption of the original 2,600 horsepower units. On the trial trip the condenser was found amply large to take care of all the steam used by the new unit and satisfactory vacuum was obtained.

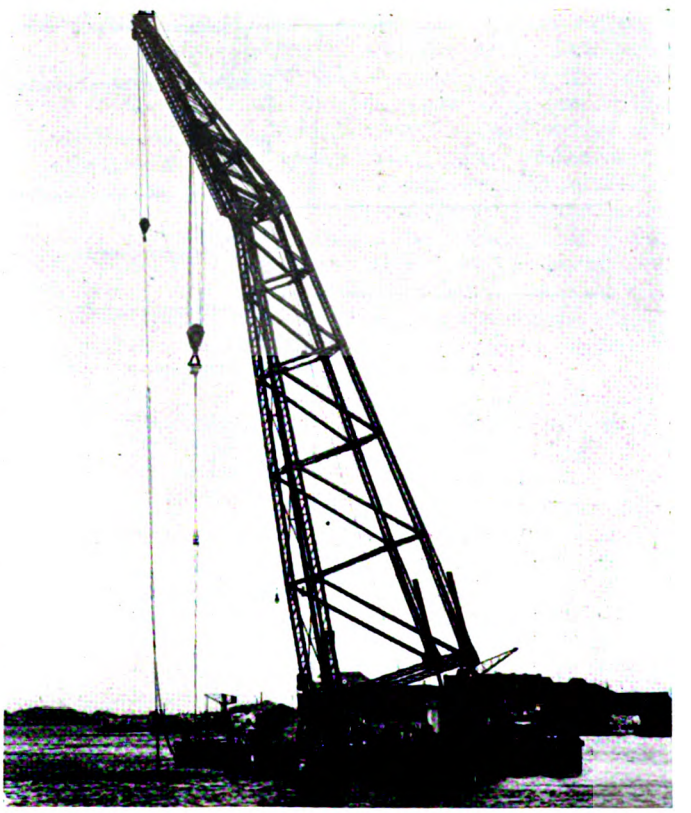
## Shipyards at Danzig Active

THE Danziger Werft, Danzig, Germany, is at present engaged in building small craft and repairing and refitting certain of the cargo vessels and cruisers which Germany has been permitted to retain in service. Nearly 3,500 men are employed at the plant. There are four building ways, each about 320 feet long, and three wet docks for fitting out vessels. Only one freighter of 2,050 British registered tonnage is being built, but a number of small craft, including two seagoing steel tugs, six trawlers and four gunboats for Poland, are under construction. The ways are equipped with four tower cranes each of five tons capacity.

The engines for the ships are also built at the plant. In addition to this work, 115 Baldwin locomotives and 25 steam cranes of the Brown Hoisting Machinery Company have been assembled.

In the repair section three obsolete type German cruisers are being rebuilt as freighters. Most of the repair work to be done at the port of Danzig is brought to this yard. In the repair section there are three drydocks 420, 390 and 250 feet long of 5,800 tons, 3,500 tons and 1,200 tons capacity respectively. The punch and shear shops, the blacksmith shop, the foundry, the coppersmith shop, the boiler shop, the joiner and welding shops are all well equipped for this sort of work and located so that fabrication of parts can be carried out in the most expeditious and efficient manner.

In the welding and cutting shop electrolytic cells of the Linde system are installed, which supply 18,000 cubic feet of oxygen and hydrogen a day. Air for the pneumatic tools is distributed over the yards in an extensive piping system.



100-Ton Floating Crane at Danzig

Repair Section of Danziger Werft, Danzig, Germany

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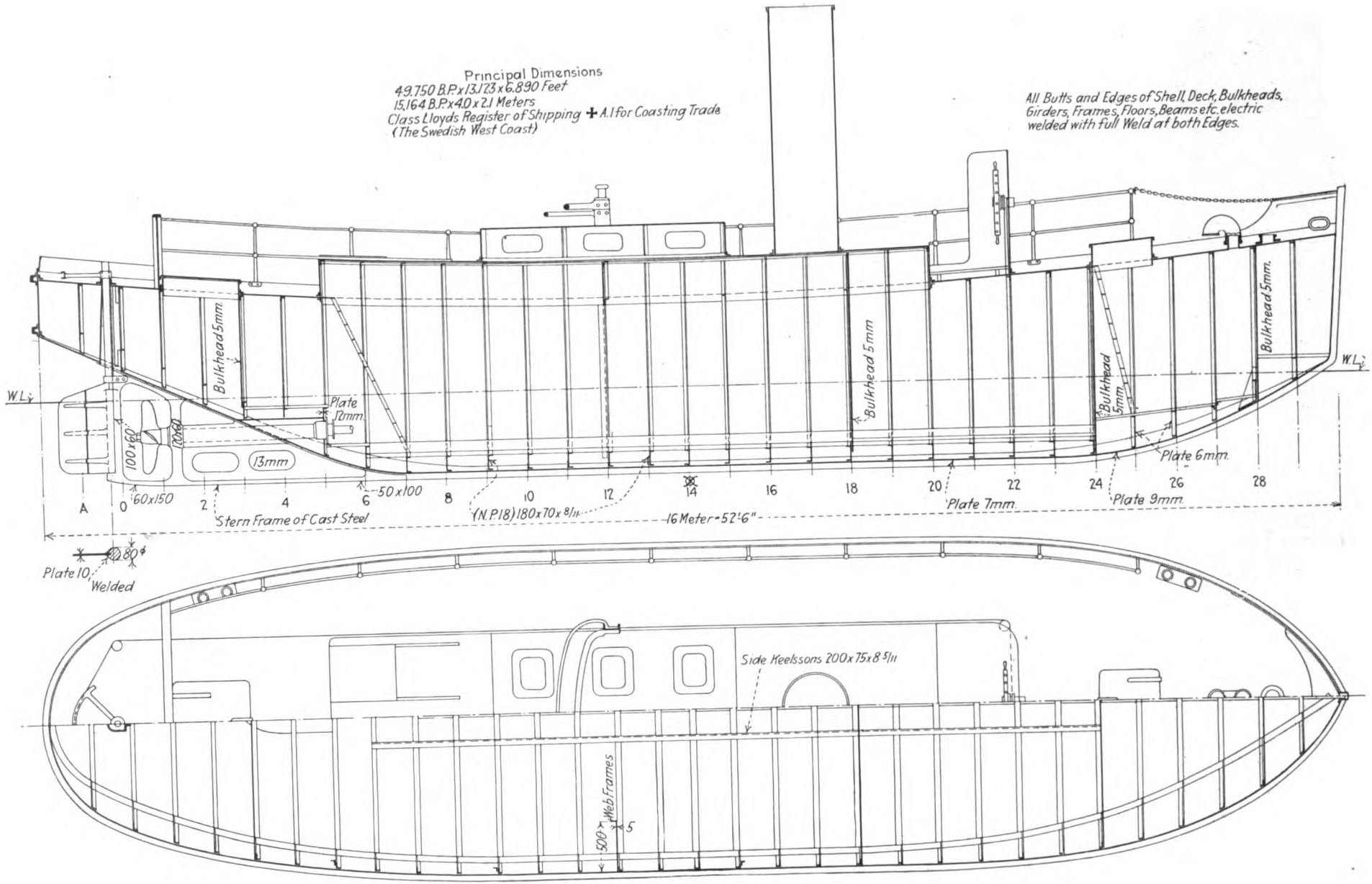


**Fig. 1.—Inboard Profile and Deck Plan of Electrically Welded Motorship Esab IV**

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# Electrically Welded Motorship Esab IV*

**By Oscar Kjellberg**

*In order to gain experience in the application of electric arc welding to shipbuilding and to test the utility of the regulations for welding issued by Lloyds and other classification societies, the board of directors of the Elektriska Svetsnings Aktiebolaget (Electric Welding Company, Ltd.) at Gothenburg, Sweden, is building a 50-foot boat in which welding will be substituted for riveting. Although the experimental vessel is of small dimensions, the form is such as to introduce a number of large flat plates with a view to obtaining information relative to the efficiency of welding for the flat bottom and sides usually found in modern steamships.*

PLANS for the steel motorship *Esab IV*, which is 52 feet 6 inches long overall, 49 feet 9 inches length between perpendiculars, 13 feet 1½ inches beam and 6 feet 10½ inches depth, were prepared by Professor A. H. Lindfors for the Elektriska Svetsnings Aktiebolaget, Gothenburg, Sweden, and submitted to Lloyd's Register, the Bureau Veritas and the Swedish Board of Trade for approval for construction of the vessel under special survey to the highest class. The shape of the bottom, bilges and, to a certain extent, sides is different from the usual practice, but this form was chosen for the purpose of obtaining some experience in this small vessel of the behavior of large plates and plane surfaces with welded connections which otherwise could be obtained only in a very much larger vessel.

## Method of Welding

As shown by the detail sketches the bottom plating is lapped on the keel and welded, the plates at the bilge overlapped and welded to an inside angle bar and all seams of the shell plating overlapped and welded. The butts of the bottom are also overlapped but at the sides the plates are placed end to end and butt welded, the frame flanges serving as butt straps. Butts and seams of the deck plating are also butt welded, the seams being strapped by a T-bar extending from beam to beam and the butts located on the deck beams.

There are 5,850 feet of welded connections in the vessel. The welded overlaps are, however, considerably smaller than riveted overlaps. All welded connections are welded with full welds except in the engine casing, where broken or spot welding is applied. The full weld has great advantages not only in regard to strength, but also in preventing the parting of plates due to rusting between the surfaces. It is considered advisable in regard to safety as well as maintenance to apply full welds to all connections below the main deck. For the welding of casings and bulkhead stiffeners, etc., the easier and cheaper system, which is approved by the classification societies, might be used.

Full welds are made overhead without any difficulty so that the use of a light fillet is not necessary.

All connections in the hull, including deck and casings, are welded, only the skylight being bolted to the casing top in order to facilitate shifting when heavy parts of the machinery are to be lifted in or out. The machinery of the vessel consists of an oil motor of about 40 brake horsepower adapted for driving either the propeller or two generators for electric welding. In addition there is an oil motor driven air compressor for supplying power to the pneumatic tools.

## Conclusion

The building and welding of this vessel has not been carried out contin-

*From a paper read before the Association of Naval Architects, Stockholm, Sweden, May 4, 1921.

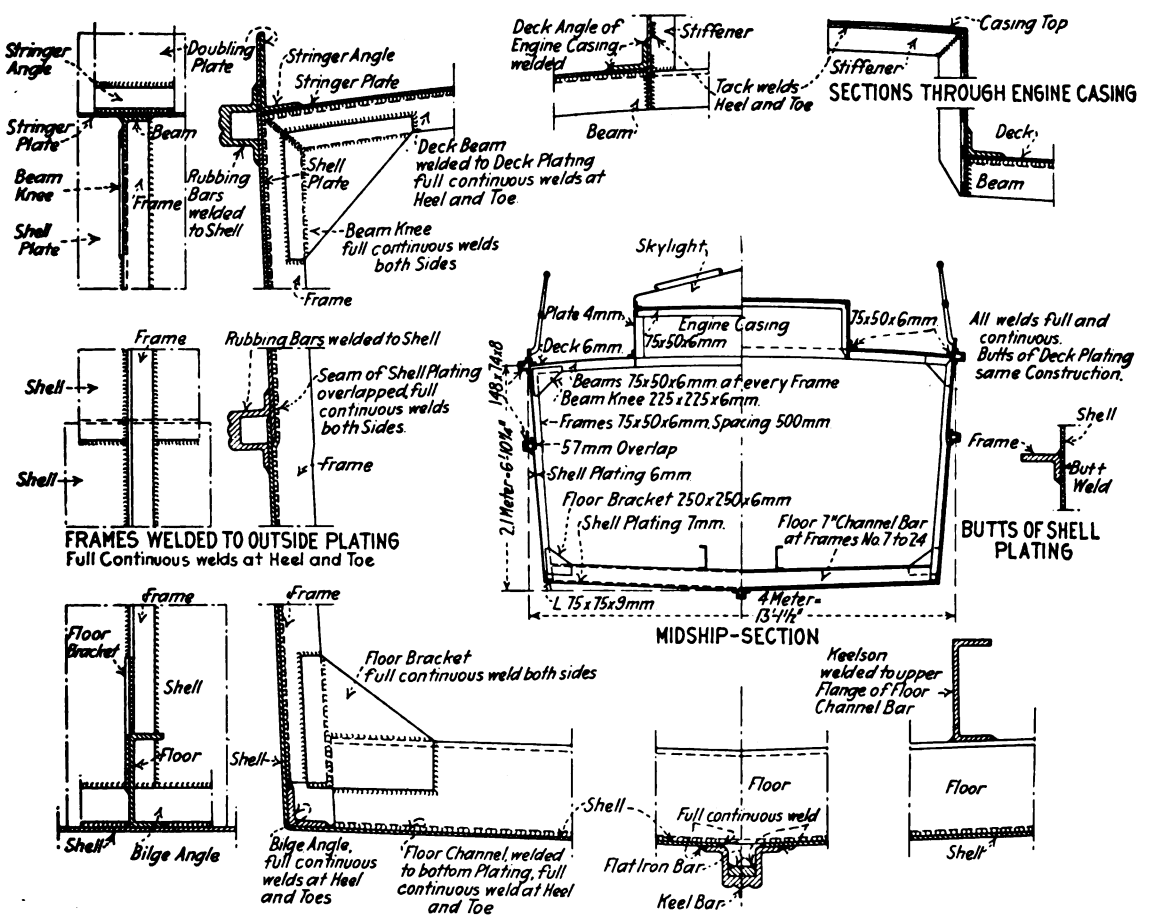


**Fig. 2.—Midship Section and Details of Welding, M. S. Esab IV**



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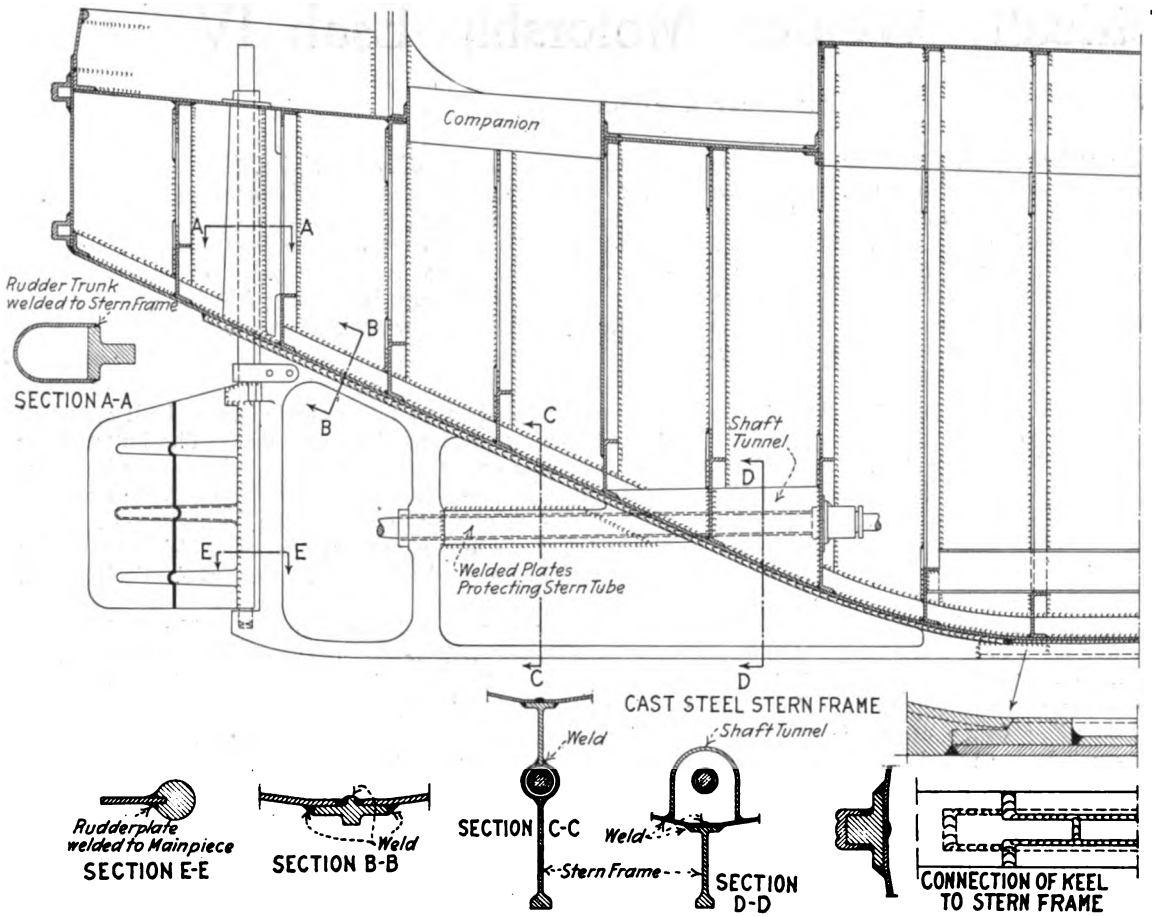


**Fig. 3.—M. S. Esab IV: Details of Welded Connections at Stern**

uously but has been done in leisure hours. For this reason no accurate costs have been obtained and the actual costs have naturally risen somewhat higher than they would have if the work had been going on without interruption. Nevertheless it can be said that the results of the comparisons which have been possible indicate that in shipbuilding on a larger scale electric welding is able to compare favorably with riveting in regard to cost. Moreover there are the great advantages on the side of electric welding that the welded connections are considerably stronger and tighter than riveted joints and that a saving of material can be effected which is not to be despised.

It might be stated that the welding in the *Esab IV* exceeds materially the demand of the classification societies. The reason for this is the special service for which the vessel is intended, for as a floating workshop it will often be moored between large ships and will in this position be serving as a fender between them.

## Locking Device Gives Stockless Anchors Positive Gripping Action

IN order to overcome the disadvantage experienced by the stockless anchor dragging over the ground without holding, a locking device has been perfected by the American Steel Foundries, Chicago, Ill., which restores what might be called the "hook" action possessed by the old type anchor. In the latter case the combined weight of the anchor shank, stock and chain tends to hold the point of one of the flukes in contact with the ground. When the stockless type was developed this positive grip on the ground was lost because it was found necessary to swivel the shank to the flukes, so that the flukes might fall in the direction of pull of the vessel. Since the flukes were not held rigidly at an angle with the bottom and the shank simply rested on the ground without forcing the flukes to dig in as in the old type, the anchor had a tendency to drag along the ground before it would grip effectively.

The device shown in the accompanying illustrations was developed to overcome this difficulty by automatically locking the shank of the stockless anchor to the flukes when the anchor is in its holding position. It also automatically releases the flukes when the shank is in the vertical position. It accomplishes this by means of two counterweighted pawls attached to either side of the shank which engage with dogs on the flukes. The pawls act in opposite directions, only one being engaged at a time so that whichever way the flukes fall, the shank is immediately locked. Now when the anchor drags, the angle which the flukes make with the bottom is so

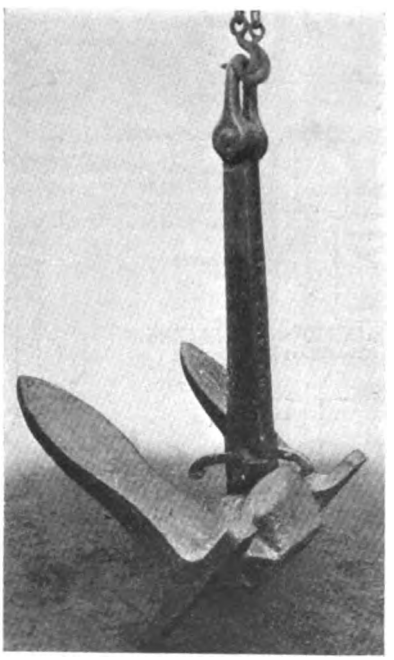

**Fig. 1.—With Shank in Vertical Position Counterweights Disengage Pawls Permitting Flukes to Rotate Freely in Either Direction**

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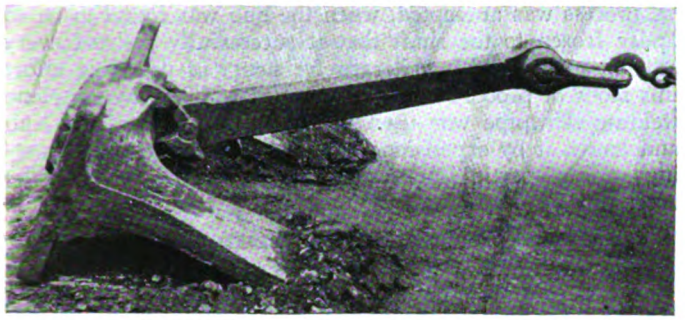


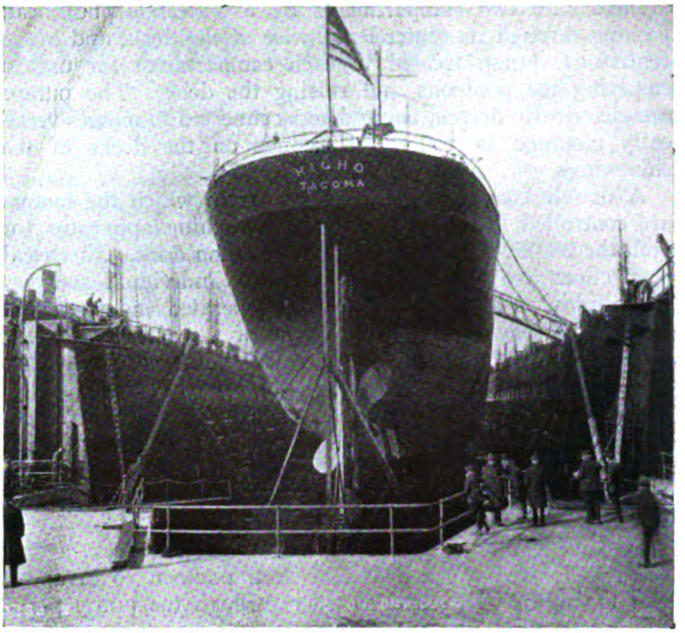
Fig. 2.—With Shank in Horizontal Position Pawls Lock the Flukes at an Angle with the Shank Causing the Anchor to Grip the Bottom

great that they are forced to dig in immediately. When the shank is raised to a vertical position the head of the pawl is carried out of a depression on the anchor and the counterweight prevents it from dropping back into the depression until the anchor is again in the holding position and the shank lowered to the horizontal. When the anchor is brought up to the ship the locking device is automatically disengaged and the flukes are free to rotate. The device is designed so that the pawls will not interfere with the stowing of the anchor in the hawse-pipe.

In a comparative test recently held with a 4,000 pound stockless anchor and a 3,000 pound anchor equipped with the locking device, the latter began to bury itself before it had been dragged more than two or three feet while the anchor without the lock was dragged about forty feet without showing any signs of digging in. The device has been approved by both the American Bureau of Shipping and Lloyd's Register of Shipping. This locking device was originated by A. Trevor Jones, American Steel Foundries.

## 6,000-Ton Floating Dry Dock at Sparrow's Point

THE Bethlehem Shipbuilding Corporation, Ltd., completed in February of this year their second floating dry dock at the Sparrow's Point plant, Sparrow's Point, Md., the construction of which was a part of the original project for the operation of two docks at that point, within the Baltimore district. The first floating dock



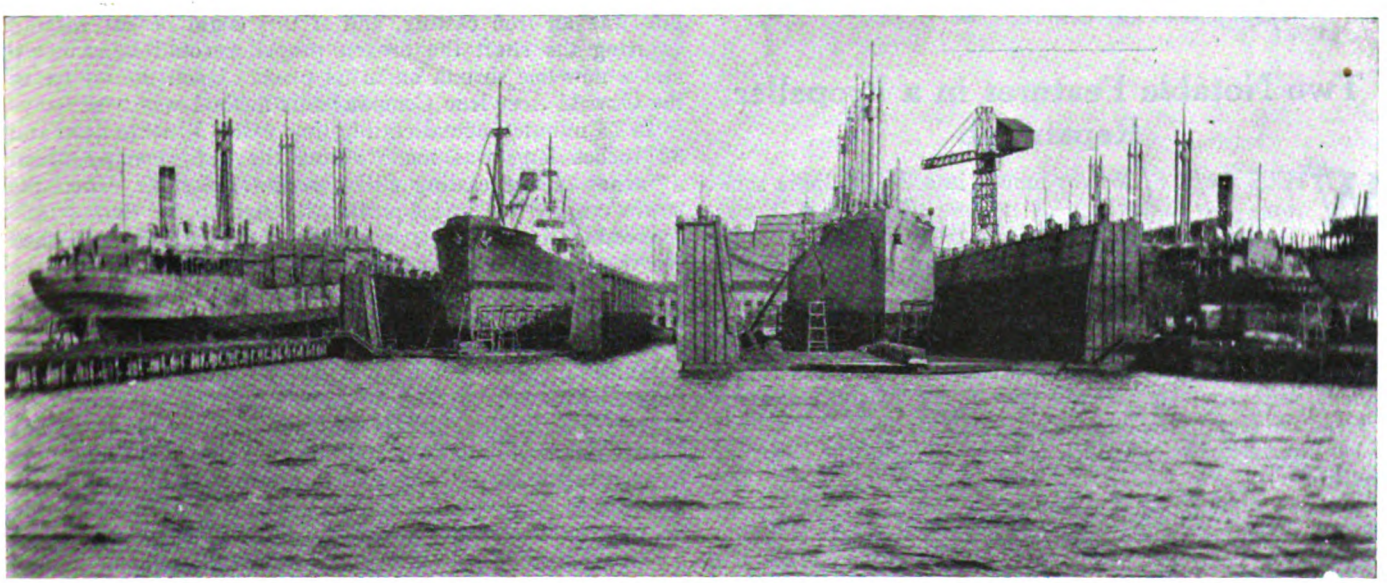
The First Vessel to Be Docked in the New 6,000-Ton Dock at Sparrow's Point

at Sparrow's Point (described on page 661, *Marine Engineering*, October, 1919) was put in operation in March, 1919, and has a lifting capacity of 20,000 tons.

The new dock has a capacity of 6,000 tons, is 418 feet in length by 100 feet in width, and is suitable for taking a vessel of 20-foot draft. It is located alongside of the 20,000-ton dock, making use of the pier and bulkhead planned and constructed for this purpose when the concrete work for the larger dock was put in. The piers at either side of the two docks have pile foundations and extend out into the bay a distance of 1,260 feet. Material in the new dock is handled by means of a locomotive crane.

### Type of Construction

In type of construction the new dock is similar to the 20,000-ton dock, being of the pontoon type, with individual wooden pontoons and continuous side wings of steel. There are eleven pontoons, which are attached to the side wings in such a manner that the wings act as continuous girders extending the full length of the dock. Each pontoon is



View from Bay Showing the Two Floating Dry Docks at Sprrrow's Point Plant at Bethlehem Shipbuilding Corporation, Ltd.

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divided into two compartments by a watertight bulkhead passing through its center lengthwise of the dock, and has a centrifugal pump located in each compartment for use in emptying the pontoons and raising the dock. The pumps are electrically driven, being direct-connected to motors vertically mounted in watertight casings on the decks of the side wings.

A double control house on shore, from which the motors are controlled, houses the electrical switching apparatus for both the 20,000-ton dock and the 6,000-ton dock. Electrical connections are such that by means of individual switches the pumps of any pontoon can be operated independently of those of the others, or by means of a master switch the pumps of all pontoons can be operated simultaneously. This feature provides means whereby the stresses in the vessel being docked may be equalized by utilizing the individual control and bringing a decreased or increased upward pressure to bear on certain pontoons, as required.

### METHOD OF SUBMERGING

For filling the pontoons and submerging the dock, a gate valve is located in each end of each pontoon so arranged that the water is allowed to enter through the pump ports, but is by-passed into the dock to avoid passing through the pumps. Suitable screens are provided to prevent any material entering that would interfere with the operation of the pumps. Operation of the gate valves is by hand from hand wheels located on the decks of the wings.

The wings are 30 feet high and 12 feet wide at the base. They are of watertight construction and communicate at the base with the compartments of the pontoons. The dock is moored to the pier and bulkhead by moorings of steel construction anchored in the concrete.

### WARPING EQUIPMENT

Three electrically driven gypsies are located on the deck of each side wing for the purpose of warping ships into the dock, a double bitt being installed at each gypsy for use as a fair lead. The electric motors for driving the gypsy heads are located in the wings below the decks and are direct connected by shafting and gears to the gypsies.

William T. Donnelly, consulting engineer, of New York, prepared the plans for the dock and the construction work was done by the Sparrows Point plant of the Bethlehem Shipbuilding Corporation, Ltd. The first vessel docked was the *Higho,* on February 15. The operation of the dock has been very successful and its completion materially adds to the facilities of Sparrows Point for the quick handling of marine repair jobs of any calibre.

## Two Notable Features in a Propeller Repair Job

WHEN the S. S. *Trialos* limped into Philadelphia some time ago minus one of its propeller blades it was feared the vessel would have to be dry docked. To avoid this expense the following expedient was successfully employed:

By removing everything possible from the after portion of the ship the bow was sufficiently lowered so that water pumped into the hold would accumulate forward. The pumps were then started and, as the volume of water increased the load in the bow, the vessel gradually lifted astern. When the keel angle was such that the center of the propeller shaft cleared the waterline 12 inches, one section of the shaft was removed in the shaft alley and the aft section of the shaft jacked forward to provide clearance between the rudder post and the shaft end for wedging off the propeller.

Everything went forward as planned until the wedging-off process was attempted, when the hub was found to be so badly frozen to the shaft that it successfully resisted every attempt to budge it. After twelve hours of gruelling effort this mode of procedure was abandoned and an oxy-acetylene welding blowpipe was used in an attempt to heat the hub and loosen it by expansion; but, due to the size of the casting and its partial immersion in water, nothing could be accomplished.

### NEW METHOD TRIED

Having exhausted the usual expedients in such cases, it was decided to try an entirely new procedure that until within the past year was thought to be impossible, and which even more recently was thought to have but little practical value commercially, viz.: oxy-acetylene castiron cutting. The hub was an iron casting, and if this could be cut without injuring the shaft the broken propeller could be removed and a new one shrunk on in its place. Upon the advice of the Oxweld Acetylene Company this method was tried.

**Broken Propeller Removed Without Dry Docking Vessel**

In 25 minutes' actual cutting time a slot 5 inches deep and 32 inches long was made across the hub, leaving about 3 inches of the casting still covering the shaft, when the strain cracked the uncut portion through to the shaft. It is interesting to note that, when the cut had almost reached the opposite side of the hub, the wedges used caused the propeller to jump two inches on the shaft, after which removal was a simple matter. Two hundred cubic feet of oxygen and about 60 cubic feet of compressed acetylene were consumed in the operation, which was accomplished in less than an hour.

It is believed that this is the first time the blowpipe has been used for this specific purpose, but it is only one of a constantly increasing number of instances that conclusively disprove the early assumption that cast iron cutting is merely an interesting scientific discovery of no particular practical commercial value. It is very rapidly developing a definite field of usefulness in this day of advanced engineering economics.

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# Piping, Valves, Flanges and Fittings

**By Horace Holden Thayer***

*This is the third of a series of articles containing information regarding shipbuilding materials and their uses that is not readily obtainable from shipbuilding handbooks and other generally available sources. The articles are not intended to be a complete exposition of the subject but will be found to contain items of value to the various classes of workers who have to deal with these materials from the materials point of view. This article covers the materials used in the various systems of piping on board ship.*

PIPING, together with its accompanying flanges, fittings and valves, is of sufficient importance from a materials point of view to warrant separate consideration in this series of articles. Although in many cases the material to be used is not determined by hard and fast rules, it is governed to some extent by the type of the vessel, the individual preferences of the owner and other considerations. There are, however, definite requirements, outside of those of the specifications to which the vessel is built, which have to be obeyed and which should always be consulted. Those for this country are embodied in the Rules and Regulations of the United States Steamboat Inspection Service. Classification requirements also enter definitely where the vessel is classed and should be used as guides where not classed.

The accompanying table covering pipes, flanges and fittings has been prepared as a guide to good merchant practice and will be found to be of value when so used. In cases where two or more materials are listed for a particular service they are of approximately equal value as far as good practice is concerned. Most of the following paragraphs are written to throw light upon the table and they contain information which is felt to be helpful to a proper analysis and use of the table. The table will be found on pages 608-611.

## Pipes

The three principal pipe materials for the more important shipbuilding services are wrought steel, wrought iron and copper. Their relative values from different points of view are as follows, the first mentioned having the highest value:

(a) Strength for a given weight or cost .... Steel, Iron, Copper
(b) Low first cost ..... Steel, Iron, Copper
(c) Resistance to corrosion ..... Copper, Iron, Steel
(d) Flexibility ..... Copper, Steel, Iron
(e) Surface smoothness ..... Copper, Steel, Iron

On account of the last mentioned consideration steel pipes present a somewhat better appearance and less internal frictional resistance than iron pipes.

The fact that properly made iron pipe resists corrosion better than steel pipe is well established, regardless of arguments that may be advanced as to why it should not do so. For this reason iron pipe is listed in the table in preference to steel pipe in all cases where internal or external corrosion is an important factor, not counterbalanced by the necessity for seamless pipe.

The reliability of piping is largely a question of the manner in which it is made. Seamless drawn pipes are the most reliable. Steel of such sizes as are required on shipboard and copper and brass pipes up to and including 10 inches, of this nature, can be readily obtained. Wrought iron pipes have to be welded; larger sizes of copper pipes are made up from sheet copper and brazed; and larger sizes of brass pipes are not used. The sheet copper for the copper pipes should be hot rolled. Welded iron or steel pipes 2 inches in diameter and over for almost all services should be lap welded. This is a requirement of the United States Steamboat Inspection Service for steam and water pipes over 2 inches in diameter over which they have jurisdiction. Butt welded pipes can be used in most cases where under 2 inches in diameter and in the accompanying table no reference to the welding will be made where this is in order. Where lap welded iron or steel is specified in the table this type of welding should be used for all pipes down to and including 1¼ inches in diameter.

Copper pipes have the advantage of being readily shaped to accommodate necessary curves in the line of self incorporated expansion bends and of reducing the use of fittings to a minimum.

Lake Superior copper is the standard for copper pipes and it can be readily obtained 99.5 percent pure, which purity should be called for. The copper should be free from sulphur.

In the fall of 1918 various users of copper tubing, including the United States Navy Department and the United States Shipping Board Emergency Fleet Corporation, agreed to reduce materially the great number of sizes and thicknesses specified by them up to that time and to adopt the sizes and thicknesses of copper tubing below listed and in the future to specify no other for ordinary purposes.

Standard Sizes and Thickness of Copper Tubing

| Inside Diam., Inches | Thickness | |
|---|---|---|
| | High Pressure | Low Pressure |
| 1 | 12 B.W.G. | 12 B.W.G. |
| 1½ | 11 B.W.G. | 12 B.W.G. |
| 2 | 9 B.W.G. | 12 B.W.G. |
| 2½ | 8 B.W.G. | 12 B.W.G. |
| 3 | 7 B.W.G. | 12 B.W.G. |
| 3½ | 6 B.W.G. | 12 B.W.G. |
| 4 | 4 B.W.G. | 12 B.W.G. |
| 5 | 2 B.W.G. | 12 B.W.G. |
| 6 | 0 B.W.G. | 11 B.W.G. |
| 7 | 000 B.W.G. | 11 B.W.G. |
| 8 | 0000 B.W.G. | 10 B.W.G. |
| 9 | 0.506 inch | 9 B.W.G. |
| 10 | 0.562 inch | 9 B.W.G. |

As regards transmission of heat through the walls of the pipe, copper is in a class by itself, its conductivity being about two and one-half times that of iron and greatly superior to that of brass alloys made from it.

Provision for expansion should be made in all steam, exhaust and hot water pipes and in long leads of large pipes generally, either by expansion bends or expansion joints.

On account of the difficulty of properly coating the inside of pipes by electro galvanizing, pipes should be galvanized by the hot process. Galvanized flanges should be used with galvanized pipes and the ends of the pipes should be dipped after the flanges are on.

Pipes should be arranged to avoid pockets as far as possible and provision should be made for the proper drainage of all low points. The main value of this is to guard against damage from freezing but pocketed liquids in pipes are also objectionable on other grounds.

As a general rule piping 2 inches in diameter and over should have flanged end connections and fittings; piping under 2 inches in diameter, screwed end connections and

* Member of Rossell and Thayer, Naval Architects and Marine Engineers, Philadelphia, Pa.



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fittings. Screwed fittings are allowable for low pressure service up to and including 3 inches in diameter, but 3-inch screwed fittings are not standard practice except for such service as bilge piping. There are also special cases where standard screwed end connections under 2 inches in diameter are not permissible.

### FLANGES

Flanges for steel or iron pressure piping are generally of forged steel, and for copper pressure piping of brazing metal or forged steel. Cast iron flanges are generally used for steel, or iron, and copper low pressure piping.

The connection of flanges to the more important pipes has to satisfy United States Inspection Service requirements.

### FITTINGS

Unions used in place of flanges on pipes of small diameter are classed as fittings. They are generally of malleable iron and such unions should have ground joints and brass or brass to iron seats. It will therefore be understood that where cast iron fittings are called for in the table the unions used on the pipes under 2 inches in diameter are of malleable iron. Where other fittings are of brass the unions are usually of brass to correspond. Where other fittings are extra heavy the unions are also extra heavy.

A general guide to the selection of fittings is as follows:

| | *Flanged fittings* | *Screwed fittings* |
|---|---|---|
| (a) Boiler pressure steam lines | Cast Steel or X Hvy. Composition, or Cast Iron to suit pressure | Forged Steel or Cast Iron to suit pressure |
| (b) Boiler pressure water lines | Cast Steel or X Hvy. Composition | Cast Steel or X Hvy. Composition |
| (c) Reduced pressure steam lines on open deck and supply or pressure lines generally | Cast iron to suit pressure | Cast iron to suit pressure |
| (d) Reduced pressure steam lines other than (c) and fuel oil discharge lines | X Hvy. Cast Iron | X Hvy. Mall. Iron |
| (e) Brass pipe | Brass | Brass |
| (f) All others including suction lines generally, except for ammonia and similar special services | Std. Cast Iron | Std. Mall. Iron |

It will be noticed that malleable iron is extensively used for the screwed fittings on small pipes but that cast iron is considered preferable for such fittings when on pressure lines.

Galvanized fittings should in general be used with galvanized pipes but when they are of cast iron and have a metal thickness of ½ inch or more the galvanizing may be dispensed with.

### VALVES

Valves for superheated steam have cast steel body and bonnet and forged steel crosshead, the other parts being preferably of compositions stated in the writer's article on "Non-Ferrous Metals and Alloys" in the July issue. Other high pressure valves and low pressure valves are preferably compositions as there stated, although the latter in most cases when in sizes of 2 inches and over may have cast iron bodies. Moderate pressure valves, except for superheated steam, may also be of some such composition as ferrosteel. Valves 2 inches and above should in general be flanged and those below 2 inches screwed. The catalogues of standard manufacturers of valves are excellent guides to a proper selection of valves of the various types, as these manufacturers produce for the many uses only what will meet the requirements of the different classification societies and the United States Steamboat Inspection Service.

The following is a good guide to body materials for the general run of valves:

| | |
|---|---|
| Cast Steel— | All valves subject to superheated steam; steam valves and feed discharge valves 2 inches and above subject to boiler pressure; boiler blow valves at boilers; throttle valves. |
| Extra Heavy Bronze— | All valves below 2 inches subject to full boiler pressure except boiler blow valves at boilers and valves in superheated steam lines. |
| Ferrosteel or equal— | Valves 2 inches and above in reduced pressure steam lines except on open deck; oil pressure valves, 2 inches and above; ammonia valves. |
| Bronze— | Valves below 2 inches in reduced pressure steam lines except on open deck; oil pressure valves below 2 inches; sea valves and cocks. |
| Brass— | Valves and cocks for all except a few special services, if not in any of the above lists, when below 2 inches. |
| Cast Iron, Composition fitted— | Valves and cocks for all except a few special services, if not in any of the above lists, when 2 inches and above. |

As stated in the writer's earlier article, the bronze valves should be gun metal when 4 inches and over but may be of valve bronze when 3½ inches and less.

### STEAM POWER SUPPLY SYSTEM

Starting with the boiler we may note that tubes, drums and other piping parts of watertube boilers are supplied by the manufacturers of the boilers in accordance with their standard practices and that the only piping materials customarily required for fire tube boilers are the tubes and mountings. The tubes should preferably be of charcoal iron on account of its superior resistance to corrosion. When charcoal is used as the fuel for melting and refining the material from which the iron is made, there are no impurities introduced by the fuel into the metal with which it comes in contact; hence the superiority of charcoal iron over iron produced by the use of coke as fuel.

The best steel tubing for boiler tubes is that which has been spellerized. The spellerizing process consists in alternately rolling the piece of metal from which the pipe is made through rolls having regularly shaped projections on them and through smooth faced rolls. This works the surface of the metal in a manner somewhat similar to the puddling of wrought iron and gives to it a uniformly dense texture better adapted to resist local corrosion, such as the pitting of boiler tubes.

As previously stated, copper is the ideal material for pipes where a rapid transmission of heat through the metal is desired. Other considerations operate to prevent its extensive use for boiler tubes in marine boilers, but the United States Steamboat Inspection Service allows copper tubes of small diameter and copper steam drums in the construction of watertube boilers where liquid fuel is used.

Seamless drawn steel is generally specified for main steam pipes of high pressure installations, on account of the previously mentioned reliability of this piping. It is desirable even for pipes of small diameter in the machinery spaces on account of the greater probability of serious results from defective pipes in these spaces. Copper main steam pipes are also good practice and have the advantages previously referred to. By-pass connections are usually of copper and cast iron. It should be remembered that the copper should be ordered hot rolled.

In connection with the use of brazed flanges on copper steam pipes the writer recalls having to deal with a main steam pipe on a steamship which had for the second time given way at a brazed flange. There was perhaps more than the usual amount of vibration to be dealt with. The writer authorized the fitting up of a new section of pipe in a manner to make the flange merely a backing piece and coupling. When the vessel was in port again, some months

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later, the writer ascertained that this had remedied the trouble.

Engine receiver piping is generally of copper or cast iron but seamless drawn steel is sometimes used. The copper pipes have brazed metal flanges.

Copper is the most approved material for auxiliary steam pipes where exposed to the weather; but an installation consisting of main deck lines of lap welded iron, galvanized, with copper branches to the individual machinery units and copper expansion bends, affords slight grounds for legitimate unfavorable criticism.

Where the appearance is of sufficient weight to warrant the additional expense, brass pipes, unions and fittings are used for exposed steam and exhaust piping to steering engines, etc., in quarters; and good practice calls for such piping in the pilot house for this reason as well as to have the piping of non-magnetic material.

### STEAM POWER EXHAUST SYSTEM

The principal factors determining the material for main exhaust piping are the sizes and forms of conduit necessitated by the particular installation. In many cases copper is found to be most desirable, in others cast iron, and in others conduits built up of steel plates and angles.

The remarks in the next to the last paragraph of the preceding section dealing with the "Steam Power Supply System" apply also to exhaust piping. Where not exposed to the weather, large sizes of auxiliary exhaust piping are usually of copper, and small sizes of standard iron or steel, preferably the former.

### STEAM HEATING SYSTEMS

Steam heating pipes in the pilot house should be of brass on account of the desirability of having them of non-magnetic material.

Steam pipes for heating cargo or bunker oil are of standard black iron unless the pipes are bent to make the grids or formed into coils, in which case they should be extra heavy. The piping is put together in suitable lengths for easy repairs and removal, with joints made by the use of flange unions.

On account of the high heat conductivity of copper, previously referred to, this metal is generally made use of for heating coils where high efficiency or compact installations are factors. Copper is, however, attacked by fuel oil and cannot be used for heating that liquid; it has been found that rigidity is a sufficient factor in some cases to make brass tubing preferable in evaporators.

### POWER PLANT FRESH WATER SYSTEM

Feed pipes for donkey boilers and other small powered installations are sometimes of brass, iron pipe sizes, with brass fittings.

A point to be borne in mind with the use of copper feed water piping is that if there are any low places or pockets not properly drained, which retain the water, it will become acidified and this acidification is a factor in producing boiler corrosion.

### POWER PLANT SALT WATER SYSTEM

Circulating water suction and discharge piping for steam engine installations is preferably of copper on account of the forms required or the vibration to be dealt with. Sections of cast iron may be employed in many cases without evil results.

Condenser tubes are preferably of Admiralty metal. Tinned Muntz metal tubes can be used, but they are inferior to the Admiralty metal tubes and have little or no advantage in first cost.

In some cases condenser tubes are drawn or pierced from a hollow casting in the nature of a short, thick walled tube; in other cases the metal is rolled into slabs from which blanks are cut, after which these blanks are cupped and then drawn or pierced as in the operation first mentioned. The proper condition of the inside of the tube can be more definitely assured and a uniform thickness of the walls can be more readily obtained when the tube is formed from a rolled slab of uniform thickness, both sides of which are exposed to plain view, than when formed from a tubular casting.

The working of the condenser tubes in the process of their manufacture produces internal strains which, unless removed by proper treatment, result in cracks. A sure method to determine if a run of tubes has been properly so treated is to immerse a section of the tubing in a 10 percent solution of mercurous nitrate for fifteen minutes. If there are strains in the metal, cracks will develop which will gradually disintegrate the piece of tubing. If there are no internal strains, the tubing will not be affected at all. Another means that is sometimes specified as a guarantee of freedom from internal strains is based on the great differences in the grain structure of all brass compositions, as the metal passes through the various processes from the original casting to hot and cold working, drawing, annealing, etc. These specifications call for the taking of micrographs, which for Admiralty mixture condenser tubes will show a grain size generally from .015 to .035 millimeter diameter, with .055 millimeter as a maximum size. The method of measuring the size of the grains is that adopted by the American Society for Testing Materials. This specification is also of value in securing tubes having that uniformity of structure which tends to reduce local corrosion and pitting to a minimum.

### BILGE AND BALLAST SYSTEMS

Usage makes bilge piping an exception to the general practice of having flanged fittings on pipes over 2 inches in diameter, and the better practice of including the 2-inch pipes in this category, as malleable iron screwed fittings are usually employed. It should be installed in suitable lengths to admit of ready removal for cleaning, repairs, etc., the lengths being connected by flange unions.

Expansion and terminal bends generally are standard lead pipe, which should be 99½ percent pure, with galvanized cast iron flanges; but copper should be used for expansion bends where the exposed piping is run through deep tanks. The writer has had considerable experience with collapsed lead expansion bends in such spaces.

The practice of galvanizing the flanges and ends of piping after the flanges are on is particularly important in the case of the bilge and ballast piping.

In many cases the ballast system has to serve as an oil fuel system, and it should in such cases be laid out to satisfy the requirements of that service.

### SANITARY SYSTEM

In installations where the sanitary main makes connection to the engine water service, the sanitary pump discharge piping should be of brass, iron pipe sizes, with galvanized cast iron flanges and brass fittings.

### DRINKING WATER SYSTEM

The circulating water coils in the distiller should be heavily tinned.

### PLUMBING

Butt welded iron or steel pipes are entirely satisfactory for waste pipes of any size.

### LUBRICATING OIL SYSTEM

Piping may be of brass, copper or seamless drawn annealed steel. The piping on reciprocating engines is preferably of brass.

All screwed piping should be reamed at the ends to

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remove burrs and all iron or steel pipes and fittings should be thoroughly cleaned by pickling, and cast iron fittings also cleaned by sand blasting, before being installed.

Flanged joints should be made to all tanks, strainers, filter or separator, pumps, turbines, gear casings and manifolds, and in all cases in brass piping connections. Flanges should be brazed to copper pipes. Sufficient flanged joints and unions should be provided to facilitate inspection and disassembling of piping.

### Oil Fuel System

Diesel engine fuel oil piping is preferably of seamless drawn steel tubing properly annealed and thoroughly freed of burrs, dirt, etc.

Copper piping or bends cannot be used for ordinary fuel oil service.

### Cargo Oil System

Standard weight piping is in most cases suitable for the whole installation, including the discharge pipes. This does not, however, include the sliding pieces in expansion joints, which should be of extra heavy pipe, turned true.

### Refrigerating System

The pipes are lap welded iron, or steel, preferably the former; and to guard against any possible porosity of the welds of the iron pipe it should be double welded. Copper or brass cannot be used with ammonia for piping, fittings or valves. Carbonic acid, on the other hand, is absolutely neutral toward metals.

Some manufacturers of iron and steel pipe have special ammonia pipe for refrigerating service, and this is particularly advisable for iron pipe which is to be bent. For pipes 2 inches and larger special ammonia or redrawn pipes are also advisable.

To insure against leaks in the cooling lines in holds and ships' refrigerated rooms the coils or grids are preferably in continuous electric welded lengths. The screwed couplings at grid terminals should be faced off at both ends and provided with faced locknuts and grommets.

One or more of the classification societies specifies that brine circulating pipes shall not be galvanized on the inside.

### Air Piping

Starting and injection air piping for oil engines is in general seamless drawn steel tubing properly annealed and pickled. Copper tubing is used where conditions are such as to require it.

Piping from air pump to air tank and from tank to whistle may be of steel, copper or brass. Steel piping exposed to the weather should be galvanized.

The only satisfactory materials for voice tubing thus far discovered are of the nature of the brass compositions specified in the writer's article on "Non Ferrous Metals and Compositions" in the July issue. Voice tubes made of vulcanized fibre have been tried out, but it was found, as might have been expected, that the voice would not carry in them. The writer understands that the Bureau of Construction and Repair of the Navy Department has been experimenting along other lines with a view toward obtaining substitutes for the standard voice tubing.

### General Utility Piping

The table does not cover the great variety of piping that is used on a ship for purposes other than as conduits. Such pipes are mainly of iron or steel, galvanized when exposed to the weather. Brass is used where the magnetic effect of iron or steel has to be avoided, or where desired for the sake of appearance. The most important of such uses are the standard weight galvanized steel pipe used for rails and stanchions, awning supports, hand rails and pipe berths, the standard and extra heavy black steel pipes used for masts and booms, chain pipes and hold stanchions, and the double extra heavy black steel pipes used for long and heavily loaded hold stanchions.

### Consumable Stores

The following is a good list of engineer's consumable stores of pipes, fittings and valves, for one ship:

**Pipes**

| | Quantity, in Feet |
|---|---|
| Brass Pipe, I. P. S., ¼", in 12-foot lengths | 24 |
| Iron Pipe, galvanized, extra heavy, ½", ¾", 1", 1¼", 1½", 2", two 12-foot lengths each lap welded where 1¼" and over | 144 |

**Pipe Fittings**

| | |
|---|---|
| Malleable Iron Bushings, galvanized, reducing one size, ⅜", ½", ¾", 1", 1¼", 1½", 2", six each size | 42 |
| Malleable Iron Elbows, galvanized, 90 degree, ¼", ⅜", ½", ¾", 1", 1¼", 1½", 2", six each | 48 |
| Cast Iron Flanges, galvanized, threaded, st'd companion, 1¼", 1½", 2", four each, faced and drilled | 12 |
| Wrought Iron Nipples, close and shoulder, ¼", ⅜", ½", ¾", 1", three each size and type | 30 |
| 1¼", 1½", 2", two each size and type | 12 |
| Iron Plugs, galvanized, ¼", ⅜", ½", ¾", 1", six each | 30 |
| 1¼", 1½", 2", four each | 12 |
| Malleable Iron T's, galvanized, ¼", ⅜", ½", ¾", 1", six each | 30 |
| 1¼", 1½", 2", four each | 12 |
| Malleable Iron Unions, ground joint, brass to iron seats, galvanized, ¼", ⅜", ½", ¾", 1", four each | 20 |
| 1¼", 1½", 2", two each | 6 |

**Valves**

| | |
|---|---|
| Brass Pet Cocks, T handles, ¼" | 12 |
| Brass Valves, angle and globe, union bonnets, screwed ends, extra heavy, ¼", ⅜", ¾", 1", three each size and type | 24 |
| 1¼", 1½", 2", two each size and type | 12 |

## Table of Requirements for Ships' Piping Systems

**Steam Power Supply System**

| Service | Pipes | Flanges | Fittings |
|---|---|---|---|
| (1) Boiler tubes | Charcoal Iron | | |
| (2) Boiler mountings | Copper | Brazing Metal | |
| | X Hvy. Lap Welded Iron. | Forged Steel | Cast Steel or X Hvy. Composition |
| (3) Main steam | S. D. Steel | Forged Steel | Cast Steel for flanged fittings; Forged Steel for screwed fittings |
| | Copper | Brazing Metal or Forged Steel | |
| (4) By-pass and receiver piping | Copper | Brazing Metal | |
| (5) Aux. steam in machinery spaces— | | | |
| (a) Full pressure 2 inches diameter and over | S. D. Steel | Forged Steel | Cast Steel or X Hvy. Comp. or C. I. to suit pressure |
| | Copper | Brazing Metal | |
| (b) Full pressure under 2 inches | Lap Welded Steel or Iron, to suit pressure | Forged Steel | Forged Steel or C. I. to suit pressure |
| (c) Reduced pressure | Std. Lap Welded Iron | Forged Steel | X Hvy. C. I for flanged fittings, X Hvy. Mall. Iron for screwed fittings |
| (6) Steam to deck machinery | Copper | Brazing Metal | |
| | Lap Welded Iron to suit pressure, galvd., with copper branches | Forged Steel galvd. for iron pipes and Brazing Metal for copper pipes | C. I. galvd. to suit pressure for flanged fittings, X Hvy. C. I. galvd. for screw fittings |
| (7) Steam to whistle | Copper | Brazing Metal | |
| | S. D. Steel, galvd. | Forged Steel, galvd. | Cast Steel or C. I. to suit pressure, galvd. |

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| Service | Pipes | Flanges | Fittings |
|---|---|---|---|
| (8) Aux. steam other than (5), (6) and (7) | Galvanized where exposed to the weather | | |
| (a) Full pressure 4 inches diameter and over | S. D. Steel | Forged Steel | Cast Steel or C. I. to suit pressure |
| (b) Full pressure under 4 inches diameter | Lap Welded Steel or Iron to suit pressure | Forged Steel | C. I. to suit pressure for flanged fittings; X Hvy. C. I. for screwed fittings |
| (c) Reduced pressure | Std. Lap Welded Iron | Forged Steel | X Hvy. C. I. for flanged fittings; X Hvy. Mall. Iron for screwed fittings |
| (9) Steam jet | X Hvy. Lap Welded Iron | Forged Steel | Forged Steel |
| (10) Expansion bends | Copper | Brazing Metal or Forged Steel | |
| **Steam Power Exhaust System** | | | |
| (11) Escape pipe— | | | |
| (a) Where exposed to the weather | Copper | C. I. galvd. | |
| (b) Branches to safety valves | Copper | C. I. | |
| | Std. Lap Welded Iron | Forged Steel or C. I. | Std. C. I. |
| (12) Main exhaust to condenser | Copper | C. I. | |
| | Cast Iron | | |
| | Riveted Steel | Steel Angles | |
| (13) Exhaust from deck machinery | Copper | C. I. galvd. | |
| | Std. Iron, galvd. with copper branches | Forged Steel or C. I. galvd. | C. I. galvd. to suit pressure for flanged fittings; Std. C. I. galvd. for screwed fittings |
| (14) Aux. exhaust generally | Copper | Forged Steel or C. I. | |
| | Std. Iron | C. I. | Std. C. I. for flanged fittings; Std. Mall. Iron for screwed fittings |
| | Iron pipes, flanges and fittings galvanized where exposed to the weather | | |
| (15) Expansion bends | Copper | Forged Steel | |
| **Steam Smothering System** | | | |
| (16) Lines to holds, lamp lockers, etc. | Std. Lap Welded Iron, galvd. | Forged Steel, galvd. | C. I. to suit pressure, galvd. |
| **Steam Heating Systems** | | | |
| (17) Heating accommodations | Std. Iron | | X Hvy. C. I. for flanged fittings; X Hvy. Mall. Iron for screwed fittings |
| | Copper expansion bends with screwed fittings brazed on | | |
| | Brass | | Brass |
| (18) Heating oil in holds and dbl. bottom— | | | |
| (a) Supply and drain pipes | Std. Lap Welded Iron | Forged Steel or C. I. | X Hvy. C. I. for flanged fittings; X Hvy. Mall. Iron for screwed fittings |
| (b) Straight pipes in tanks | Std. Lap Welded Iron | (X Hvy. C. I. flange unions) | |
| (c) Coiled or bent pipes in tanks | X Hvy. Lap Welded Iron | | |
| (19) Heating water tanks, galley sink, etc. | Std. Iron, galvd. | | X Hvy. Mall. Iron, galvd. |
| (20) Galley steam service | Std. Iron, galvd. | | X Hvy. Mall. Iron, galvd. |
| (21) Feed water heater coils | Copper | | Special unions |
| (22) Evaporator coils | Copper or Brass | | Special quick detachable joints |
| (23) Brine heater coils | Copper | | Special unions |
| (24) Pipe in fuel oil heaters | S. D. Steel | | |
| **Blow Piping** | | | |
| (25) Boiler blows | Copper | Brazing Metal or Forged Steel | |
| (26) Evaporator blow | Copper | Brazing Metal | |
| | Std. Iron, galvd. | Forged Steel, galvd. | Std. C. I. galvd. |
| **Power Plant Fresh Water System** | | | |
| (27) Air and condensate pump suction and discharge | Copper | Forged Steel or C. I., galvd. | |
| (28) Vapor from evaporater | Std. Iron, galvd. | | Std. Mall. Iron, galvd. |
| (29) Feed and general service pumps suction from feed and filter tank, condenser or tanks | Copper | C. I. galvd. | |
| | Std. Iron, galvd. | C. I. galvd. | Std. Mall. Iron, galvd. |
| (30) Feed and general service pumps discharge to boiler-feed lines | Copper | Brazing Metal or Forged Steel, galvd. | |
| | S. D. Steel, galvd. 2 inches and over; | Forged Steel, galvd. | Cast Steel, galvd. or X Hvy. Composition |
| | X Hvy. Iron, Lap Welded, under 2 inches, galvd. | Forged Steel, galvd. | |
| (31) Pump reliefs— | | | |
| (a) Pressure lines | Copper | Brazing Metal | |
| (b) Non-pressure lines | Std. Iron, galvd. | C. I. galvd. | Std. Mall. Iron, galvd. |
| (32) Feed and general service pumps discharge overboard or to feed and filter tank | Copper | C. I. galvd. | |
| (33) Feed pump discharge to reserve feed tank | Std. Iron, galvd. | C. I. galvd. | Std. C. I. galvd. for flanged fittings; Std. Mall. Iron for screwed fittings |
| (34) Injector suction from reserve feed tank | Std. Iron, galvd. | C. I. galvd. | Std. Mall. Iron, galvd. |
| (35) Injector discharge to boiler or aux. feed lines | Copper | Brazing Metal | |
| (36) Injector discharge to deck or engine room | Std. Iron, galvd. | C. I. galvd. | Std. C. I. galvd. |
| (37) Boiler circulating pump suction and discharge | Copper | Brazing Metal | |
| (38) Expansion bends | Copper | Brazing Metal or Forged Steel, galvd. | |
| **Power Plant Salt Water System** | | | |
| (39) Circulating water suction and discharge piping | Copper | C. I. galvd. | |
| (40) Condenser tubes | Admiralty Metal | | Brass Ferrules |
| (41) Pump suctions generally | Copper | C. I. galvd. | |
| (42) Pump discharges overboard and circulating water | Copper | C. I. galvd. | |
| | Std. Iron, galvd. | Forged Steel or C. I. galvd. | Std. C. I. galvd. |
| (43) Evaporator feed pump suction | Brass I. P. S. | C. I. galvd. | Std. Brass |
| | Std. Iron, galvd. | C. I. galvd. | Std. Mall. Iron, galvd. |
| (44) Evaporator feed pump discharge to evaporator | Brass I. P. S. | | Std. Mall. Iron, galvd. |
| | Std. Iron, galvd. | C. I. galvd. | |
| (45) Pump reliefs | Std. Iron, galvd. | | Std. Mall. Iron, galvd. |
| **Bilge and Ballast Systems** | | | |
| (46) Bilge mains | Std. Iron, galvd. | (Mall. Iron flange unions, galvd.) | Std. Mall. Iron, galvd. |
| (47) Ballast mains | Std. Iron, galvd. | C. I. or Forged Steel, galvd. | Std. C. I. galvd. |

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| Service | Pipes | Flanges | Fittings |
|---|---|---|---|
| (48) Expansion bends in deep tanks | Copper | C. I. galvd. | |
| (49) Expansion and terminal bends generally | Std. Lead | C. I. galvd. | |
| (50) Pump and syphon suctions in machy. space or holds | Std. Iron, galvd. | C. I. galvd. | Std. C. I. for flanged fittings and Std. Mall. Iron for screwed fittings |
| (51) Pump and syphon discharges | Std. Iron, galvd. | Forged Steel or C. I. galvd. | |
| | Copper | C. I. galvd. | |
| (52) Pump reliefs | Std. Iron, galvd. | | Std. Mall. Iron, galvd. |
| (53) Hand pump suction and overboard discharge | Std. Iron, galvd. | C. I. galvd. | Std. Mall. Iron, galvd. |
| **Fire and Deck Wash System** | | | |
| (54) Mains | Std. Lap Welded Iron, galvd. | Forged Steel, galvd. | Std. C. I. galvd. |
| (55) Fire pump suction | Copper | C. I. galvd. | |
| (56) Fire pump discharge to fire main | Std. Lap Welded Iron, galvd. | Forged Steel, galvd. | Std. C. I. galvd. |
| (57) Fire pump relief | Std. Iron, galvd. | | Std. Mall. Iron, galvd. |
| (58) Hand pump discharge to fire main | Std. Iron, galvd. | C. I. or Forged Steel, galvd. | Std. C. I. galvd. |
| **Sanitary System** | | | |
| (59) Mains | Std. Iron, galvd. | C. I. or Forged Steel, galvd. | Std. C. I. galvd. |
| (60) Sanitary pump suction | Copper | C. I. galvd. | |
| (61) Sanitary pump discharge to mains | Std. Iron, galvd. | C. I. or Forged Steel, galvd. | Std. C. I. galvd. |
| (62) Sanitary pump relief | Std. Iron, galvd. | | Std. Mall. Iron galvd. |
| **Fresh Water System** | | | |
| (63) Pressure lines | Std. Iron, galvd. | C. I. or Forged Steel, galvd. | Std. C. I. galvd. |
| (64) Suction, gravity and drain lines | Std. Iron, galvd. | C. I. galvd. | Std. C. I. galvd. for flanged fittings; Std. Mall. Iron galvd. for screwed fittings |
| (65) F. W. pump suction and relief | Std. Iron, galvd. | C. I. galvd. | Std. C. I. galvd. for flanged fittings; Std. Mall. Iron galvd. for screwed fittings |
| (66) F. W. pump discharge | Std. Iron, galvd. | C. I. or Forged Steel, galvd. | Std. C. I. galvd. |
| **Drinking Water System** (Same as fresh water system) | | | |
| (67) Distiller coils | Copper | | Special unions |
| **Plumbing** | | | |
| (68) Supply piping where not exposed to view | Std. Iron, galvd. | | Std. C. I. galvd. |
| (69) Deck and other drain pipes where not exposed to view | Std. Iron, galvd. | | Std. C. I. galvd. for flanged fittings; Std. Mall. Iron galvd. for screwed fittings |
| (70) Exposed supply piping in petty officers', engineers' and crew's quarters | Std. Steel, galvd. | | Std. C. I. galvd. |
| (71) Exposed drain piping in petty officers', engineers' and crew's quarters | Std. Steel, galvd. | | Std. Mall. Iron galvd. |
| (72) Exposed piping in passengers' and officers' quarters | Some such composition as Benedict nickel | | To match pipes |
| | Brass, nickel plated | | To match pipes |
| (73) Main waste piping | Std. Iron, galvd. | C. I. galvd. | Std. C. I. galvd. |
| | Lead ¼" thick | C. I. galvd. | |
| **Filling, Air and Sounding Pipes** | | | |
| (74) Filling pipes | Std. Iron, galvd. | C. I. galvd. | Std. C. I. galvd. for flanged fittings; Std. Mall. Iron galvd. for screwed fittings |
| (75) Air pipes | Std. Iron, galvd. | C. I. galvd. | Std. C. I. return bends above deck; Std. Mall. Iron galvd. generally |
| (76) Sounding pipes | Std. Iron, galvd. | | |
| (77) Air pump, etc., stand pipes | Std. Iron, galvd. | | Std. Mall. Iron, galvd. |
| **Machinery Water Service** | | | |
| (78) Pump discharge to water service | Brass I. P. S. | C. I. galvd. | Std. Brass |
| (79) Steam engine piping | Brass I. P. S. | | Std. Brass |
| (80) Oil engine piping | | | |
| (a) 2" and over | Std. Iron, galvd. | C. I. or Forged Steel, galvd. | Std. C. I. galvd. |
| (b) Under 2" | Brass I. P. S. | | Std. Brass |
| (81) Oil engine jacket water piping | Copper | Brazing Metal | |
| | Brass I. P. S. | | Std. Brass |
| (82) Thrust piping | Brass I. P. S. | | Std. Brass |
| (83) Line shaft bearings | Brass I. P. S. | | Std. Brass |
| | Std. Iron, galvd. | | Std. C. I. galvd. |
| (84) Drain piping to bilge | Std. Iron, galvd. | | Std. Mall. Iron galvd. |
| (85) Cooling coil in thrust bearing | Copper | | Brass unions |
| **Lubricating Oil System** | | | |
| (86) Mains 2" and over | S. D. Steel | Forged Steel | Std. C. I. |
| (87) Mains under 2" | Brass I. P. S. | (Brass flange unions) | Std. Brass |
| | Copper | Brazing Metal | |
| | S. D. Steel | | Std. C. I. |
| (88) Engineers' tank filling pipes | S. D. Steel | C. I. | Std. C. I. for flanged fittings; Std. Mall. Iron for screwed fittings |
| (89) Tubes in oil feed boxes | Brass | | |
| (90) Oil cooler tubes | Copper | | |
| **Oil Fuel System** | | | |
| (91) Steam plant suction piping | Std. Steel | Forged Steel or C. I. | Std. C. I. for flanged fittings; Std. Mall. Iron for screwed fittings |
| (92) Steam plant pressure piping | X Hvy. Lap Welded Steel. | (X Hvy. C.I. flange unions) | X Hvy. C. I. for flanged fittings; X Hvy. Mall. Iron for screwed fittings |
| (93) Expansion bends | Same as piping | Forged Steel or C. I. | |
| (94) Diesel plant piping from pump to cylinders | Copper | Brazing Metal | |
| (95) Filling pipes from deck | Std. Steel | Forged Steel or C. I. | Std. C. I. for flanged fittings; Std. Mall. Iron for screwed fittings |
| (96) Oil heater tubes | S. D. Steel | | |

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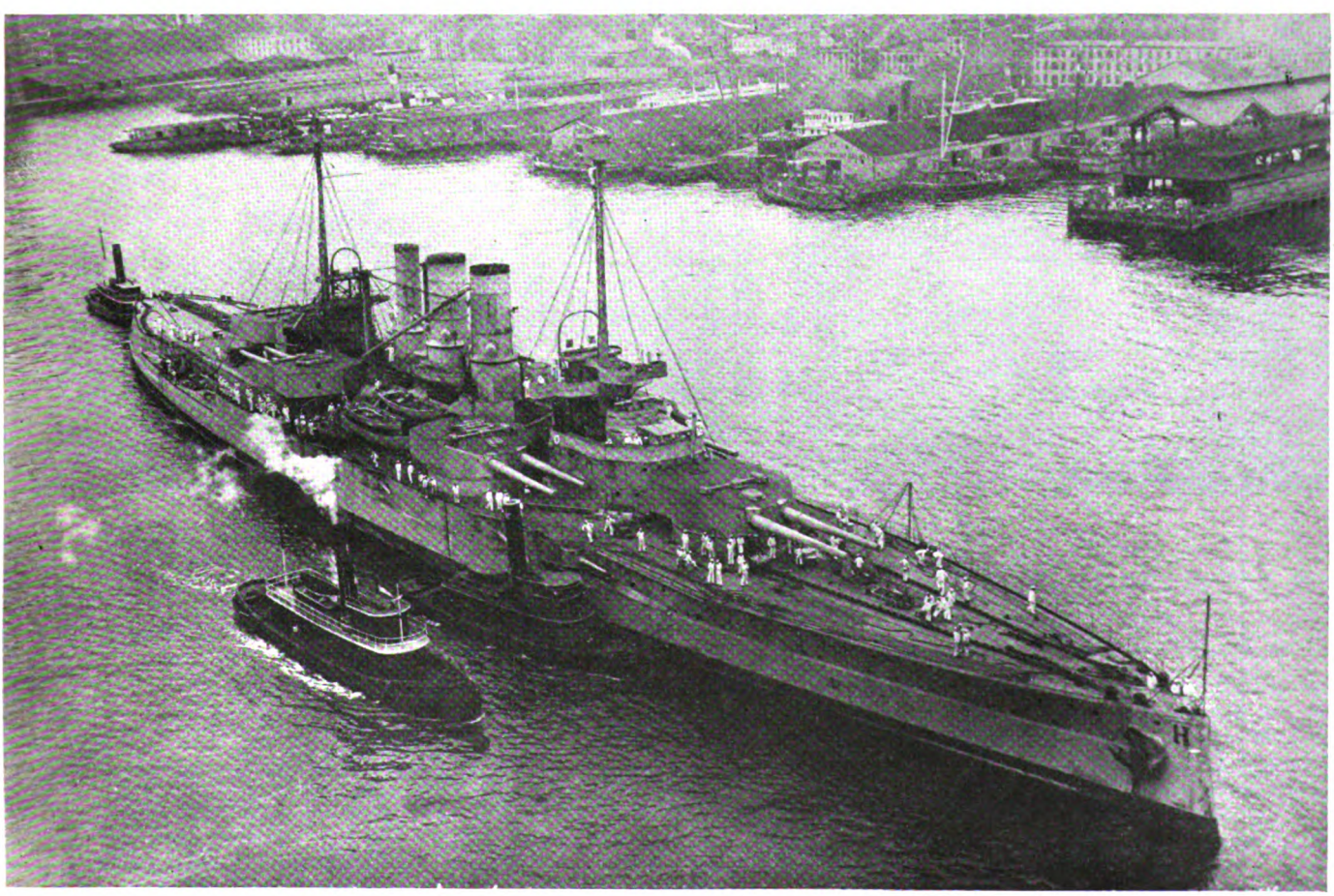
| Service | Pipes | Flanges | Fittings |
|---|---|---|---|
| (97) Gasoline piping | Copper<br>Brass I. P. S. | | Brass unions<br>Std. Brass |
| **Cargo Oil System** | | | |
| (98) Filling pipes | Std. Steel | C. I. | Std. C. I. |
| (99) Discharge mains | Steel to suit pressure | C. I. or Ferrosteel | C. I. to suit pressure |
| (100) Overboard discharge pipes | Std. Steel | C. I. | Std. C. I. |
| (101) Expansion bends | Steel to suit pressure | C. I. or Ferrosteel | |
| **Refrigerating System** | | | |
| (102) Pump discharge to ice machine | Std. Iron, galvd. | C. I. galvd. | Std. C. I. galvd. |
| (103) Circulating water piping | Std. Iron, galvd. | | Std. C. I. galvd. |
| (104) Ammonia piping and dbl. pipe condenser | X Hvy. Lap Welded Iron, galvd. | Forged Steel special, galvd. | Mall. Cast Steel return bends; Semi-steel flanged fittings; Mall. Iron screwed fittings special |
| (105) Carbonic acid piping and dbl. pipe condenser | X Hvy. Lap Welded Iron, galvd. | C. I. galvd. | Semi-steel flanged fittings; Mall. Iron screwed fittings special |
| (106) Ammonia or carbonic acid coils in brine coolers | X Hvy. Lap Welded Iron | | Special couplings |
| (107) Brine piping coils or grids | Std. Lap Welded Iron, galvd. | | Special couplings |
| (108) Brine piping feed and return pipes | X Hvy. Lap Welded Iron, glvd. | C. I. galvd. | Std. C. I. galvd. |
| (109) Coils in carbonic acid shell type of condenser or cooler | Copper | | Special couplings |
| (110) Scuttle butt coils | X Hvy. Lap Welded Iron, galvd. | | Std. C. I. galvd. |
| **Miscellaneous** | | | |
| (111) Starting and injection air piping for oil engines | S. D. Steel | Forged Steel | Cast Steel |
| (112) Air piping generally | Std. Lap Welded Steel<br>Brass I. P. S.<br>Copper | | C. I. to suit pressure<br>Brass<br>Brass unions |
| (113) Diesel engine relief piping | Copper | Brazing Metal | |
| (114) Oil engine exhaust piping | Cast Iron<br>Std. Steel | <br>Forged Steel or C. I. | <br>Std. C. I. |
| (115) Piping to ash ejector | Std. Iron, galvd. | Forged Steel, galvd. | X Hvy. C. I. galvd. |
| (116) Ash wetting piping | Std. Iron, galvd. | | Std. C. I. galvd. |
| (117) Engine indicator piping | Brass I. P. S. | | Brass |
| (118) Feed pump gage piping | Brass, I. P. S., to suit pressure | | Brass to suit pressure |
| (119) Gage piping generally | Steel to suit pressure | | C. I. or Mall. Iron to suit pressure |
| (120) Turbine drain piping | Copper | Brazing Metal | |
| (121) Drain piping generally | Std. Iron, galvd. | | Mall. Iron, galvd. |
| (122) Hydraulic telemotor piping | Copper | | Special couplings |
| (123) Voice tubing | Special Brass | | |
| (124) Fire extinguishing systems other than steam or water | Std. Steel, galvd. | C. I. galvd. | C. I. galvd. special in some sizes |
| (125) Electric conduits | Special Steel Tubing, galvd. | | Special couplings |



*(Photograph copyright by N. G. Moser, N. Y.*

**Former German Battleship Ostfriesland Recently Used by the United States Navy and War Departments as a Target for Bombing Tests Off the Virginia Capes**

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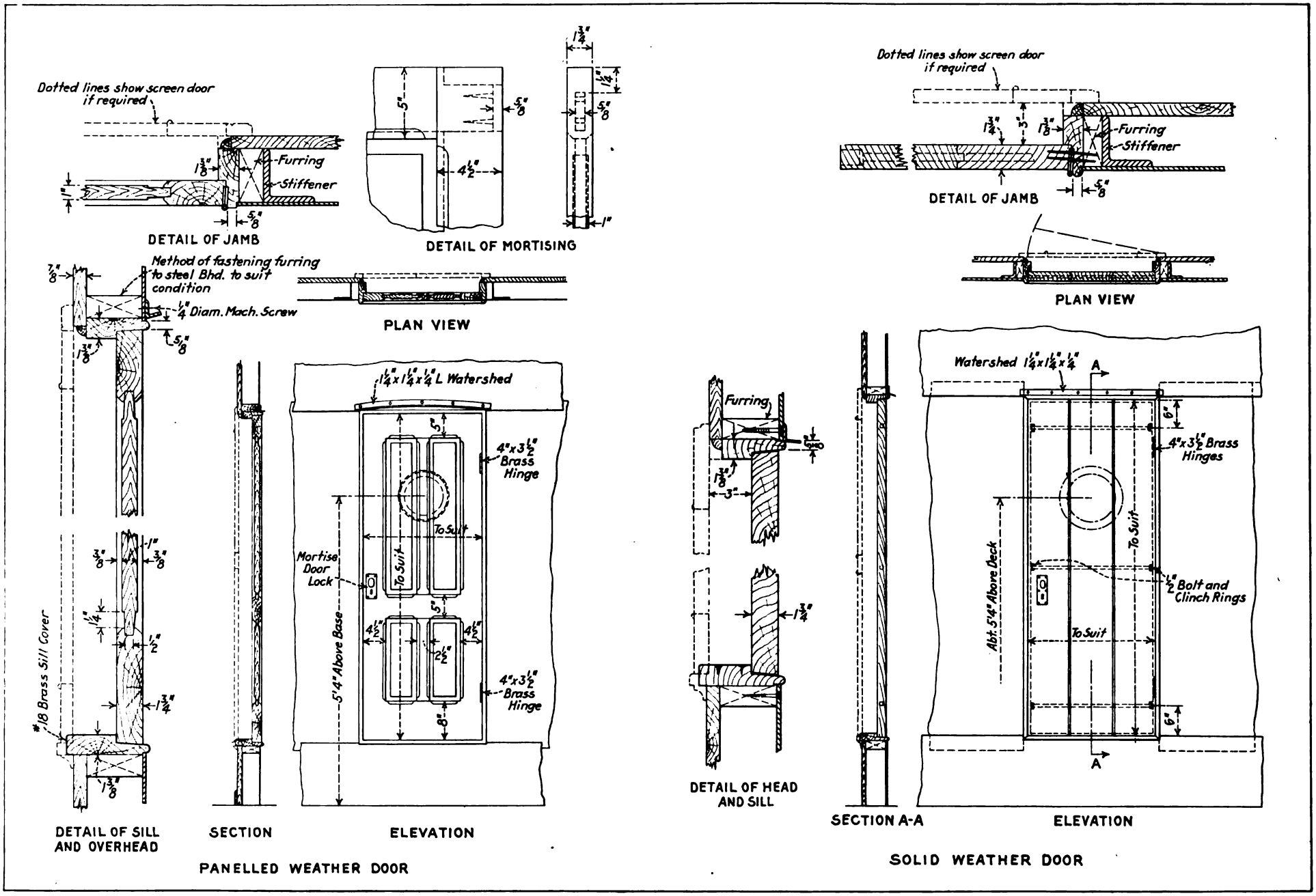
# Ship Joiner Plans

## Weather Doors



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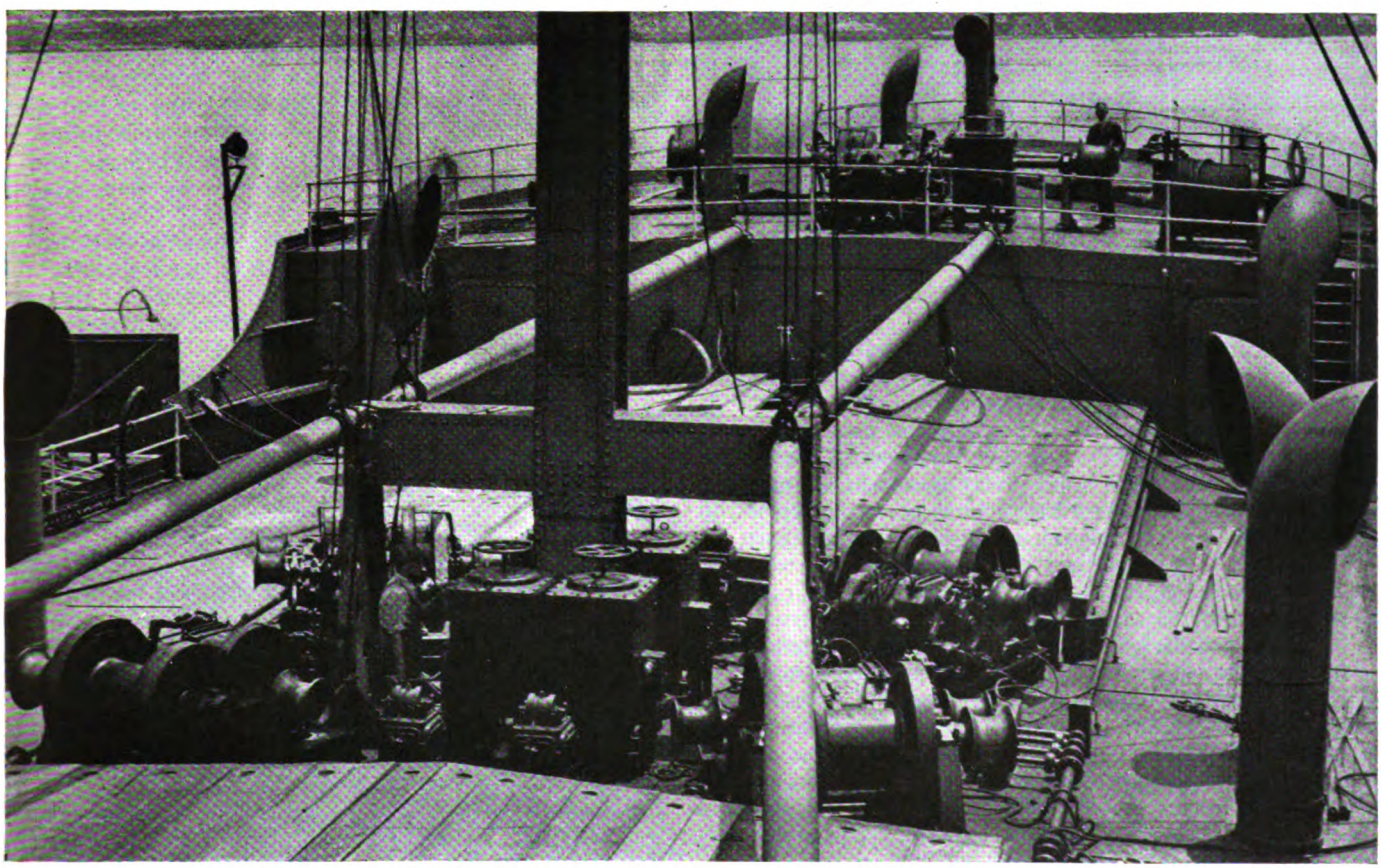
# Electric Motors for Merchant Ship Auxiliaries

**By Walter E. Thau and William H. Easton***

*It would undoubtedly surprise a marine engineer to enter a modern American hotel and discover that the elevators, ventilating fans, vacuum cleaners and other machines scattered through the building were driven by steam engines and that steam pipes ran along the corridors and passed through the rooms. Yet this is the system that is in use on practically every American merchant ship today, and this in spite of the fact that the desirability and reliability of the electric motor have become so well established that there is now no reason why steam engines should continue to be used on shipboard in ways that no one would think of using them on land.*

THERE are many reasons why the electric motor should take the place of the steam engine for driving winches, windlasses, capstans, steering gear, pumps, blowers and other auxiliary ship machinery. The motor is more efficient than the steam engine, more compact, more readily applied to a given machine and more easily controlled. It is supplied in types with so wide a variety of speed and power characteristics that exactly the right type can be obtained for driving any given machine. All of its parts that need attention are light, easily accessible and readily repaired or replaced at sea. It can be provided with automatic devices that prevent injury to the machinery because of improper operation. It is safe, clean and quiet in operation.

When steam driven winches are used, thousands of feet of steam and exhaust pipes must run through the ship. These pipes are expensive to install, are usually in the way and frequently cause undesirably high temperatures in holds or living quarters; also exposed portions are liable to freeze up in cold weather. Furthermore, the loss due to condensation and leakage is very large and occurs whenever steam is in the pipes and regardless of whether the engines are being operated or not. But with motor drive, power is transmitted by cables and wires that are easily laid, occupy no valuable space, are unaffected by cold weather and when properly installed cannot be injured in ordinary service. The losses in transmission are small and absolutely cease when the motor stops running.



**Electric Winches on the Motorship William Penn**

### General Requirements of Motors on Board Ship

But the chief reason why motor driven auxiliaries will eventually be used on all ships is that they will in time greatly expedite the handling of the cargo and thus cut down the idle time in port. It is freely conceded that in the present early stages of development the motor driven winch is not greatly superior to the steam driven winch in this respect. But the steam winch is at the end of its development, while the motor driven winch is just at the beginning; and unless the history of electricity on shipboard is vastly different from that of its application in every other field, it will eventually revolutionize our methods of cargo handling and will introduce economies now undreamed of.

*Westinghouse Electric and Manufacturing Company.



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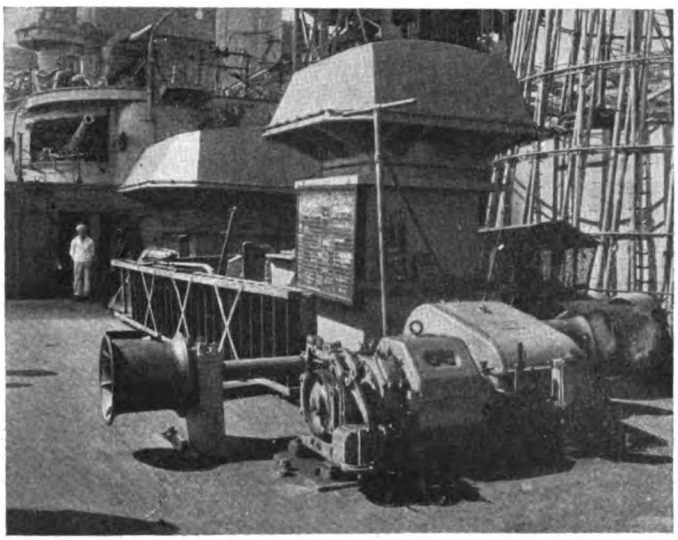
It is, however, impossible to get satisfactory results from a motor on shipboard unless it is specially designed to withstand the peculiar conditions encountered at sea and properly selected to do the particular work it is to be called upon to do. Much trouble has resulted from the attempt to use ordinary land motors on ships and only by careful study and experience have engineers been able to produce motors that are thoroughly reliable for sea service.

All electrical apparatus on shipboard must be sufficiently rugged to withstand the rough handling it is bound to receive. All insulation must be impregnated with water-proofing compounds to prevent injury from salt and moisture, and all light metal parts ordinarily made of steel, such as springs or bolts, must be either made of a non-corroding metal or be protected by a suitable finish. The bearings of motors, generators and other rotating machines must be designed to operate when tilted at a large angle by the roll of the ship. Everything mounted on the deck must be capable of withstanding total submergence for short periods and special care must be taken with deck motors to prevent leakage around the shafts.



**Motor-Driven Winch on the U. S. S. Tennessee**

Resistors for deck motors present a special problem because they heat under load. The usual practice is to enclose them in water-proof boxes with watertight doors, which are removed when the motor is in use; and these doors are sometimes electrically interlocked with the motor control circuits so that unless they are removed the motor cannot be started. In some applications, however, the resistor boxes have been designed with sufficient radiating capacity to permit operation without ventilation.

## DIRECT CURRENT VERSUS ALTERNATING CURRENT

Although direct current is being used almost exclusively for ship auxiliaries, alternating current has also found some application, so that it is desirable to consider the relative merits of the two systems.

*In Favor of Direct Current:*

Generating system simpler and more familiar to the average marine engineer.

Speed of direct current motors is high on light loads and low on heavy loads, whereas the speed of alternating current motors is about the same for all loads. In consequence, direct current provides "livelier" operation.

Loads when being lowered can be effectively controlled by "dynamic" braking when direct current is used, whereas a foot brake is needed with alterating current.

*In Favor of Alternating Current:*

Alternating current motors are somewhat simpler and more rugged.

They are ideal for constant speed applications, such as pump drives.

The squirrel cage alternating current motor is sparkless in operation.

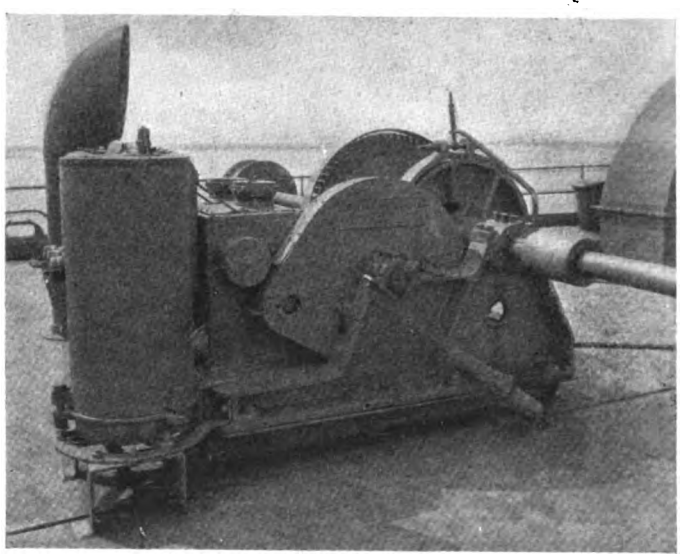
All things being considered, therefore, direct current is preferable for ship auxiliaries, though alternating current may be used for special services, such as on tankers, where the absence of sparking may be desirable. The chief reason why alternating current is used so generally on land is that it can be economically transmitted over long distances, but this advantage does not apply to ship auxiliary service.

It is well to mention in this connection that alternating current is used in the steam-electric system of propelling battleships, because of the ease with which large amounts of power can be transmitted by alternating current at high voltages and because of the inherent suitability of the alternating current generator for high speed turbine drive. But the auxiliary system of a ship is in all cases entirely separate from her propelling system, and standard United States Navy practice is to use direct current for the former, even on ships propelled by alternating current.

## DECK WINCHES

The motor that is best adapted to the requirements of the deck winch is a compound wound, direct current machine, with just enough shunt field to keep the no-load speed within safe limits. This motor develops high torque in starting, operates at slow speed with heavy loads and at high speed with light loads, and can be controlled by dynamic braking when lowering a load.

*Dynamic Braking*—Inasmuch as "dynamic braking" is not a generally familiar term, a short description of this process may be of interest. It is well known that the same direct current machine can be used either as a motor or a generator, depending upon circumstances. If electric power is supplied to it, its armature will rotate and deliver mechanical power and the machine becomes a motor. If, on the other hand, the armature is turned by means of mechanical power while the fields are excited, the machine delivers power and becomes a generator.



**Warping Winch Operated by an Alternating-Current Motor. The Motor Is Enclosed in the Watertight Box. When Operated, the Screw Plugs Are Removed to Provide Ventilation**

Consequently, when the load of a motor driven winch is allowed to descend, it turns the motor armature; and if proper connections are made, the motor becomes a generator and delivers current back into the power line or to a resistance load. Now, the speed with which a given weight

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can turn the armature of a generator depends upon the amount of current permitted to flow—the greater the flow of current, the greater the magnetic drag on the armature and the lower the speed. Hence, by controlling this current by means of the controller used to control the speed of the motor, the speed of the armature (and therefore the speed of the lowering of the load) can be controlled with extreme nicety. The advantages of this process are (1) the ease of control of the lowering speed and (2) the elimination of the foot brake, with its wear and maintenance expense. In some cases there is actual economy in the method because of the current returned to the line, but this need not be considered on ship installations.

Dynamic braking cannot be used to bring a load to a full stop and hold it suspended, because it is essentially a method of speed control and is operative only when the load is in motion; but in connection with it an electric brake is used which is automatically applied when the current is cut off, and is released when the current is turned on. Dynamic braking is in general and highly successful use in many services, ranging from the control of electric railroad trains to the handling of ladles filled with molten metal in steel mills, and its reliability is beyond question.

The controller generally used in connection with motor driven winches is of the ordinary drum type arranged for reversing and for dynamic braking. A knife switch should be provided in the case so that the controller can be disconnected for inspection or repairs without opening the main switch and stopping all of the other winches. The overload and no-voltage protective devices for the motor should also be located in the controller case, so as to make the entire installation self-contained. If the gypsy head method of hoisting is to be used (in which the gypsy head revolves slowly in one direction and the operator hoists, lowers and controls the speed of the load by tightening or loosening the rope coiled several times around the head) it is advisable to make provision for an especially slow speed.

Where alternating current is used, the winch motor should be of the wound motor type with a drum type controller and a foot brake.

The ordinary deck winch requires a motor of from 15 to 30 horsepower, but as larger motors can be readily used and the speed of handling the cargo thereby increased, the tendency is in that direction. This is an instance of the manner in which the use of electricity improves operation.

### CAPSTAN

The electrical equipment for a capstan is in general similar to that of a winch. The controller should be of the reversing type and should provide dynamic braking points for use in passing out a line under strain. If the capstan is of the overhauling type, an electric brake is needed.

A so-called "jamming" resistance is sometimes used in connection with the control of capstan motors. The purpose of this resistance is to permit the motor to maintain its pull even though it is overloaded by the strain on the hawser and the overload protective device has operated. When the jamming resistance is omitted the motor will be completely disconnected from the line under the above circumstances and will relax its pull until the controller is moved to the off position and electrical connection re-established. The jamming resistance, however, permits a little current to flow, thus retaining some tension on the hawser at all times.

As the electrical equipment of a capstan is usually mounted below deck, complete water-proofing is not essential. The capacity of a motor for the average capstan is from 25 to 35 horsepower.

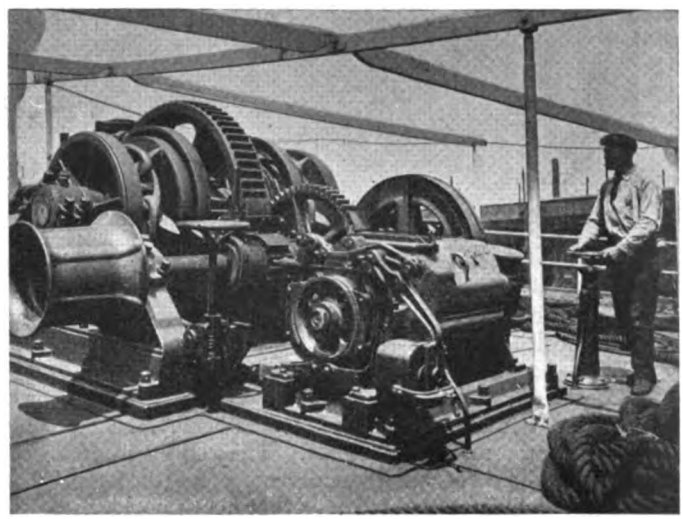
### ANCHOR WINDLASS

The electrical requirements of anchor windlasses are the same as those of capstans. As the equipment is usually mounted on the deck, it must be perfectly water-proof. Windlass motors range from 30 to 70 horsepower.

### STEERING GEAR

Electric motors are used to operate several different types of steering gear.

*Mechanical Screw Gear*—In this type the motor is geared to a screw shaft which engages right and left nuts which slide on bars connected to the tiller arm. Starting the motor in one direction turns the rudder, say, to the left,



**Anchor Windlass Driven by a Direct-Current Motor of Waterproof Construction**

and reversing the motor turns the rudder in the opposite direction.

This service imposes very severe loads on the motor, as there is no special compensation for the rudder resistance in the hard-over positions. The motor must therefore be especially strong and rugged, have ample overload capacity and be suitable for frequent reversals. Ordinarily overload protection is undesirable, for the motor must still be operative even under unusual conditions of overload, as when the rudder fouls with an obstruction or is turned to its extreme limit in either direction and is exposed to unbalanced water pressure. Consequently, the automatic overload devices must operate only under abnormal loads and must then connect the motor across the line through a jamming resistance (or if the motor is overhauled, set an electric brake) so that it will hold its grip on the rudder and automatically return to its proper functioning condition on the removal of the overhead. For small motors the ordinary rheostatic method of control is satisfactory, but for large ones the Ward-Leonard system is preferable.

The controller for the steering gear motor must be of the automatic type; that is, the actual motor connections are made by magnetic switches located near the motor, while the operation of these switches is controlled by a small master switch (which can be operated by a wheel or in any other desired manner) in the hands of the helmsman. Master switches can be located at any desired number of stations. Either a follow-up or an indicator system can be used to determine the actual setting of the rudder, though the latter seems to be gaining in popularity.

Limit switches must be employed which stop the motor at the extreme limit of the rudder in either direction, but permit operation in the opposite direction.

*Differential Gear*—In this system the motor turns a worm shaft and the worms move cranks which are connected to each arm of a double armed tiller, the proportions being so selected that the cranks turn through an angle of 180

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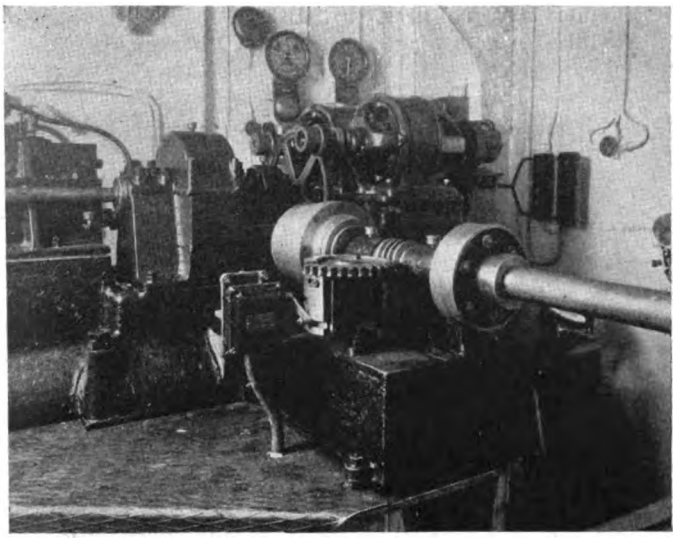
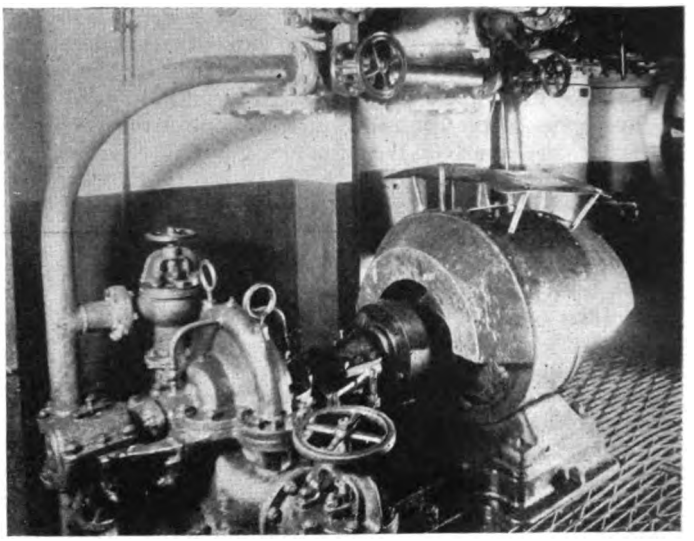


Motors Operating Hydraulic Steering Gear Mechanism



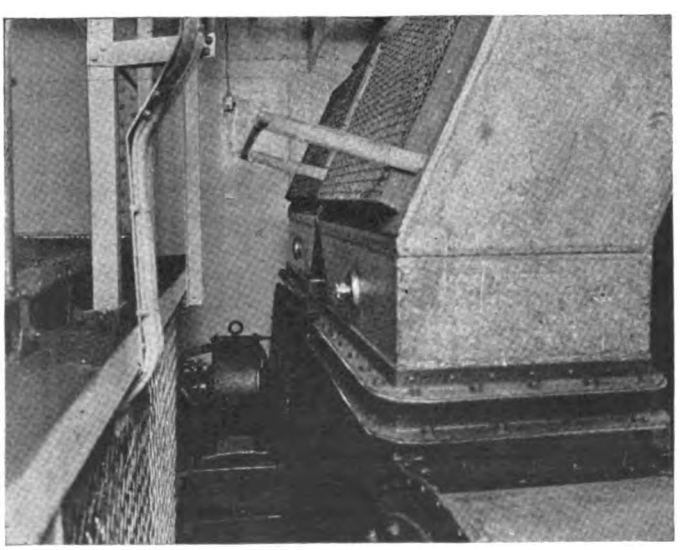
Motor Driven Pump

degrees while the tiller arms turn 70 degrees for the hard-over position. The service is similar to the screw gear, except that the loads on the motor are less severe.

*Hydraulic Gear*—The hydraulic steering gear has met with great favor in the Navy and is being used more extensively in the merchant marine. The rudder itself is turned by means of two double acting ram cylinders supplied with oil at high pressure from a continuously operated motor driven pump, the flow of the oil to the cylinders being controlled by a "tilting box" operated by a small pilot motor. The operation is as follows:

When the helmsman wishes to turn the rudder he moves a master controller in the desired direction. This starts the pilot motor, which moves the tilting box so as to admit the oil from the pump into the proper ends of the ram cylinders. The pistons then move, turning the rudder in the desired direction, and will continue to move as long as the pilot motor is in operation. An indicator in front of the helmsman shows the motion of the rudder, and when it has turned to the proper angle the helmsman moves his controller to the off position, which stops the pilot motor and also the rudder.

From the standpoint of motor drive, this application is very simple. The pump motor operates continuously in one direction at constant speed and can be either a shunt wound direct current motor or a squirrel cage alternating current motor. The small pilot motor must be suitable for constant reversals.



Motor Driven Ventilating Fan

Limit switches must be used to stop the pilot motor when the rudder reaches the limit of its travel.

The drives of pumps, ventilating fans, refrigerating machines and other auxiliary machinery on a ship do not differ materially from similar applications on land and standard motors and controllers (with special marine protection) are used for these applications.

The capacity of the auxiliary generating equipment for a ship depends upon the amount of power she will need when loading or unloading in port, as her sea load will be from 35 to 50 percent of this amount, and her load when entering port will be from 60 to 75 percent.

It would, of course, be possible to install a single generator to take care of this entire load, but actually it must be split up among at least two, and preferably three, duplicate units, while good practice calls for at least one additional spare unit. The reasons for this sub-division are: (1) the safety and the efficiency of the ship would be endangered, if additional spare units were not available for instant use in case of the failure of a unit; and (2) the most economical operation can be obtained by proportioning the number of generating units to the load requirements, thus loading the units in operation at or near their full capacity. All of the units should be exactly alike to simplify maintenance and the supply of spare parts.

*Generators*—Standard generators, of either the direct current or alternating current type, can be used in this service, provided they are protected against moisture and have bearings that can be tilted at an angle. As the transmission distances are short, no compensation for line drop is necessary and direct current machines can be flat compounded. The generators must be arranged for parallel operation and should be selected with liberal overload capacities.

*Prime Movers*—On steamships reciprocating engines have so far been generally employed for driving the generators, but turbines are now being preferred because of their lighter weight, smaller dimensions, quieter and cleaner operation and higher operating efficiency.

On motorships oil engines are preferable; and since the operation of alternating current generators in parallel by means of oil engines under the conditions encountered on board ships is not entirely satisfactory, only the direct current system should be employed.

*Switchboards*—The switching equipment for a ship's power plant does not differ materially from that used on land. It is believed, however, that it is especially good practice to use safety enclosed switches, dead-front switchboards, safety panels and other protected devices, which prevent accidental contact with live parts.

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# Problem of the Hull and Its Screw Propeller V*

## Formulas for the Design of the Propeller—Determination of the Design Point — Ratio of Pitch to Diameter

By Rear-Admiral C. W. Dyson, U. S. N.

THE data supplied the designer in order to determine upon the proper propeller to meet any given set of conditions usually come in one of three forms:

1. Required speed, effective horsepower for this speed, and revolutions of propeller desired at this speed.

2. Effective horsepower curve for the ship, designed power of the engines and revolutions of the propeller at this power.

3. Designed power of the engines and revolutions of the propeller, desired speed of vessel.

With each of these are supplied the hull characteristics of the vessel, together with distance between center of propeller hub and skin of ship or between center of hub and limiting dimensions of the propeller well.

When data of form 1 are given the problem consists in determining not only the characteristics of the propeller but also the engine power necessary to drive the vessel at the required speed.

When data of form 2 are given, in addition to the characteristics of the propeller, the maximum speed of vessel which can be obtained with the designed power of the engines is also determined.

Finally, with form 3 data, the propeller designer is in the hands of the naval architect. So far as the designer of the propeller is concerned, the ship may or may not make the desired speed with the designed power at the designed condition of load. He can only feel confident that she will make it at some load condition. To call on him for a guaranteed performance is, to say the least, an absurdity and to blame him for failure is to carry injustice to the extreme.

In selecting the point upon which to base the design Fig. 8 is used and the preliminary point or points taken will depend upon the type of vessel and the derived basic slip of the vessel. The point or points taken should be at sufficient height above the cavitation curve for the basic slip and the value of K as to insure that for any probable increase in resistance of the hull, due to deep loading, foul bottom or ordinary heavy weather conditions, the value of $v \div V$ will not be reduced to such an extent as to lower the performance point below the curve of cavitation.

### Ratio of Pitch to Diameter

The limitation for this ratio is not definitely known but for safety it is recommended that a lower value of about .75 be taken as a limit, although conditions may arise where it will be found necessary to go even lower than this value. The curve E, Fig. 8 (see May issue), need not be adhered to rigidly as the upper limit of design but this limit and the maximum limit of $\frac{\text{e. h. p.}}{\text{E. H. P.}}$ used for the adopted point of design should be regulated by the values of $P \div D$ and of P. A. $\div$ D. A. which are obtained in the calculation. It is undesirable to use a basic value of P. A. $\div$ D. A. of less than approximately .23 on account of the bluntness of blade sections which result with the smaller values.

### Formulas for Design

FORM I: DATA AS PER I

| | | | | |
|---|---|---|---|---|
| (1) $v$ (required speed)..... | $v$ | $v$ | $v$ | (Const.) |
| (2) $n \times$ e. h. p. (required effective horsepower) .... | $n \times$ e. h. p. | $n \times$ e. h. p. | $n \times$ e. h. p. | (Const.) |
| (3) $n$ (number of propellers). | $n$ | $n$ | $n$ | (Const.) |
| (4) e. h. p. (on 1 propeller).. | e. h. p. | e. h. p. | e. h. p. | (Const.) |
| (5) e. h. p. $\div$ E. H. P. (load fractions used) ..... | Val. 1 | Val. 2 | Val. 3 | (Variable) |
| (6) $v \div V$ (speed fraction for values of (5) ).... | 1 | 2 | 3 | (Variable) |
| (7) E. H. P. = (4) $\div$ (5).. | 1 | 2 | 3 | (Variable) |
| (8) $V$ = (1) $\div$ (6)..... | 1 | 2 | 3 | (Variable) |
| (9) $S$ (basic slip from hull characteristics) ..... | $S$ | $S$ | $S$ | (Constant) |
| (10) $D$ (proposed diameter)... | $D$ | $D$ | $D$ | (Constant) |
| (11) E. T.p $\times$ (P. A. $\div$ D. A.) | 1 | 2 | 3 | (Variable) |
| E. T.p $\times$ (P. A. $\div$ D. A.) = | $\begin{cases} (2.88 \times \text{E. H. P.}) \div (D^2 \times V) \text{ for 3-bladed propellers.} \\ (2.491 \times \text{E. H. P.}) \div (D^2 \times V) \text{ for 4-bladed propellers.} \\ (3.84 \times \text{E. H. P.}) \div (D^2 \times V) \text{ for 2-bladed propellers.} \end{cases}$ | | | |
| (12) P. A. $\div$ D. A. (for (11) Fig. 9) ..... | 1 | 2 | 3 | (Variable) |
| (12) = projected area ratio if the propeller is 3-bladed = basic. | | | | |
| (13) 4/3 (P. A. $\div$ D. A.) = (total projected area ratio for 4 blades)..... | 1 | 2 | 3 | (Variable) |
| (14) 2/3 (P. A. $\div$ D. A.) = (total projected area ratio for 2 blades)..... | 1 | 2 | 3 | (Variable) |
| (15) P. C. (propulsive coefficient for (12), (13) or (14) ) ..... | 1 | 2 | 3 | (Variable) |
| (16) I. H. P. = E. H. P. $\div$ P. C. = basic I. H. P.. | 1 | 2 | 3 | (Variable) |
| (17) S. H. P. = .92 $\times$ I. H. P. = basic shaft horsepower ..... | 1 | 2 | 3 | (Variable) |
| (18) $Z_p$ = Power factor for $\frac{\text{e. h. p.}}{\text{E. H. P.}}$ (Fig. 7)..... | 1 | 2 | 3 | (Variable) |
| (19) K = Power augment (Fig. 4) ..... | $K$ | $K$ | $K$ | (Constant) |
| (20) I. H. P.d or S. H. P.d = (I. H. P. $\div$ $10Z_p$ or S. H. P. $\div$ $10Z_p$) $\times$ $K$ = Est. of power..... | 1 | 2 | 3 | (Variable) |
| (21) T. S. = Tip speed for (12) ..... | 1 | 2 | 3 | (Variable) |
| (22) $1 - S = 1 - (9)$..... | $(1 - S)$ | $(1 - S)$ | $(1 - S)$ | (Constant) |
| (23) P = ($\pi$D $\times$ $V$ $\times$ 101.33) $\div$ (T. S. $\times$ $(1 - S)$ ) = Pitch ..... | 1 | 2 | 3 | (Variable) |
| (24) $Z_s$ = Speed factor for $\frac{v}{V}$, Fig. 7, Curve 1..... | 1 | 2 | 3 | (Variable) |
| (25) $s$ = ($S \times$ I. H. P.d $\times$ $10Z_s$) $\div$ I. H. P. = ($S \times$ S. H. P.d $\times$ $10Z_s$) $\div$ S. H. P. = apparent slip ..... | 1 | 2 | 3 | (Variable) |
| (26) $R_d$ = ($v \times 101.33$) $\div$ (P $\times$ $(1 - s)$ ) = estimated revolutions ..... | 1 | 2 | 3 | (Variable) |

Should the revolutions obtained be less than those desired and a good ratio of $P \div D$ exist, the revolutions may be increased in two ways, both of which produce a reduction in efficiency.

($a$) Retain original diameter and increase values of $v \div V$.

($b$) Reduce the diameter and retain the original values of $v \div V$.

By the ($a$) process the projected area ratio will be increased and the values of $P \div D$ and of $s$ will be reduced but the safety distance above cavitation will increase.

By the ($b$) process the values of the projected area ratios will be increased, $P \div D$ will remain constant and $s$ will be increased while the safety remains as originally.

($c$) A third method may also be used; that is, the rise above the original point may be made by keeping the effective thrust constant. This will maintain constant projected area ratios, reduced efficiency, decrease in $s$ and increase in revolutions but the reduction in efficiency will not be so great as in ($a$).

Should the revolutions obtained be higher than those desired follow the opposite course to ($a$), ($b$) or ($c$) and the effects will be opposite. Care must be taken to preserve suffi-

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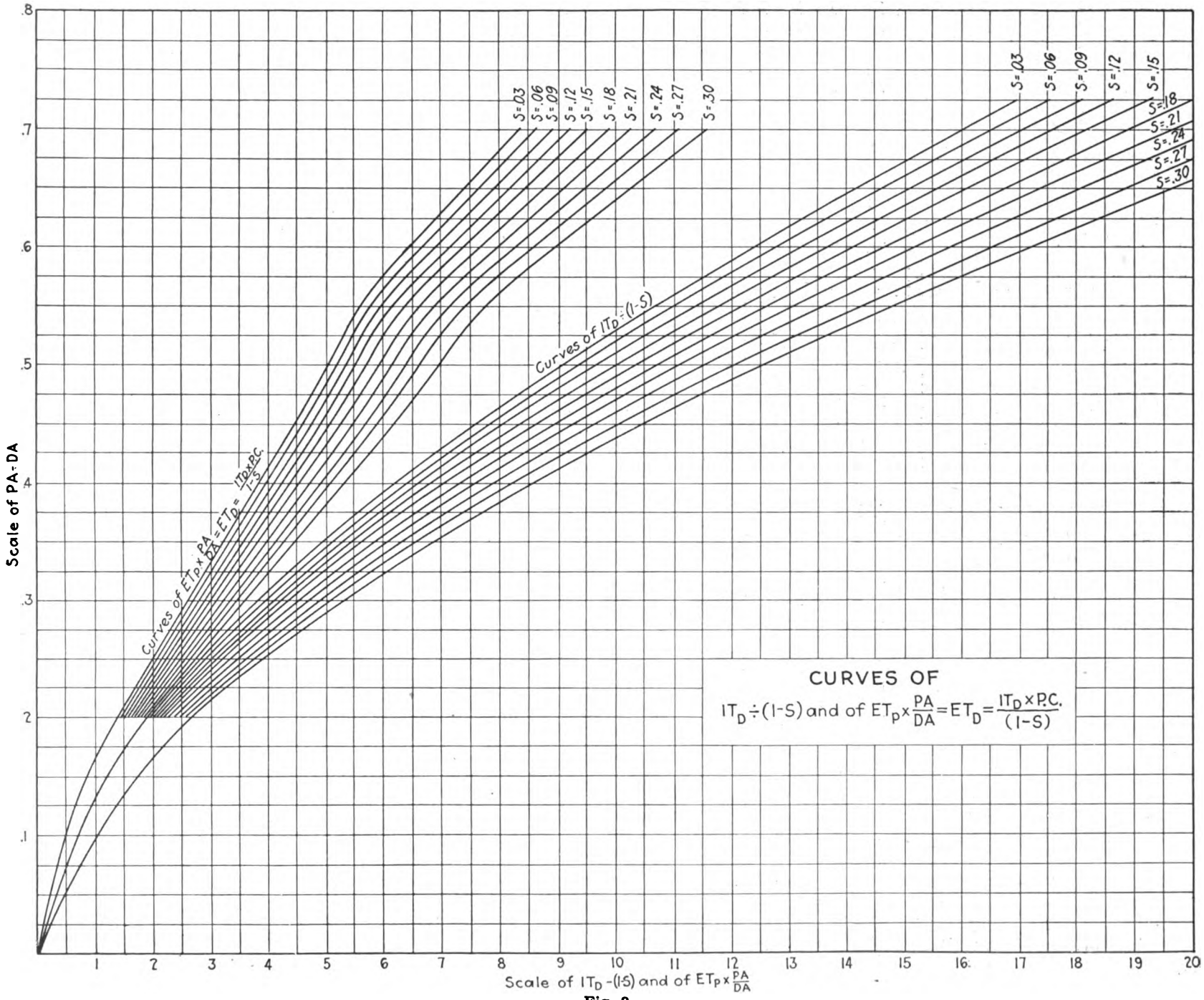
Scale of PA÷DA
.8
.7
.6
.5
.4
.3
.2
.1
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Scale of $IT_D-(1-S)$ and of $ET_P \times \frac{PA}{DA}$
S=.03 S=.06 S=.09 S=.12 S=.15 S=.18 S=.21 S=.24 S=.27 S=.30
Curves of $IT_D \div (1-S)$
Curves of $ET_P \times \frac{PA}{DA} = ET_D = \frac{IT_D \times P.C.}{1-S}$
CURVES OF
$IT_D \div (1-S)$ and of $ET_P \times \frac{PA}{DA} = ET_D = \frac{IT_D \times P.C.}{(1-S)}$

**Fig. 9**

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cient safety clearance above the cavitation curve and to do this it may be necessary to hold the $\frac{v}{V}$ constant and use a lower value of $\frac{\text{e. h. p.}}{\text{E. H. P.}}$

FORM 2: DATA AS PER 2

| | | | | |
|---|---|---|---|---|
| (1) $v$ (covering range of expected speed). | 1 | 2 | 3 | (Variable) |
| (2) $n \times$ e. h. p. (total effective H. P. for $v$'s) | 1 | 2 | 3 | (Variable) |
| (3) $n$ = number of propellers | $n$ | $n$ | $n$ | (Constant) |
| (4) e. h. p. = effective H. P. on one propeller | 1 | 2 | 3 | (Variable) |

Proceed as in form 1. Should the revolutions for the designed power be greater or less than those desired, proceed as in $(a)$, $(b)$ or $(c)$.

The expected speed will be that corresponding to the designed power and revolutions as determined by the calculations.

FORM 3: DATA AS PER 3

| | | | | |
|---|---|---|---|---|
| (1) $n$ S. H. P.$_d$ (designed shaft horsepower) | $n$ S. H. P.$_d$ | $n$ S. H. P.$_d$ | $n$ S. H. P.$_d$ | (Const.) |
| (2) $n$ I. H. P. (designed I. H. P.) = $n$ S. H. P.$_d$ $\div$ .92 | $n$ I. H. P.$_d$ | $n$ I. H. P.$_d$ | $n$ I. H. P.$_d$ | (Const.) |
| (3) $n$ (number of propellers). | $n$ | $n$ | $n$ | (Const.) |
| (4) I. H. P.$_d$ (I. H. P. on one propeller) | I. H. P.$_d$ | I. H. P.$_d$ | I. H. P.$_d$ | (Const.) |
| (5) $v$ (expected speed) | $v$ | $v$ | $v$ | (Const.) |
| (6) e. h. p. $\div$ E. H. P. (assumed load fractions) | 1 | 2 | 3 | (Variable) |
| (7) $v \div V$ = Speed fractions at assumed points on (6) | 1 | 2 | 3 | (Variable) |
| (8) $D$ (assumed diameter) | $D$ | $D$ | $D$ | (Constant) |
| (9) $S$ (basic slip for hull conditions) | $S$ | $S$ | $S$ | (Constant) |
| (10) $V = v \div (v \div V) =$ basic speed | 1 | 1 | 1 | (Variable) |
| (11) K = Power augment | $K$ | $K$ | $K$ | (Constant) |
| (12) $Z_p$ = Power factor for $\frac{\text{e. h. p.}}{\text{E. H. P.}}$ (Fig. 7) | 1 | 2 | 3 | (Variable) |
| (13) I. H. P. = I. H. P.$_d$ $\times$ $10Z_p \div K$ = basic power | 1 | 2 | 3 | (Variable) |
| (14) I. T. $\div (1 - S)$ | 1 | 2 | 3 | (Variable) |

I. T. $\div (1 - S) = \begin{cases} (2.88 \times \text{I. H. P.}) \div (D^2 \times V) \text{ for 3-bladed propellers.} \\ (2.491 \times \text{I. H. P.}) \div (D^2 \times V) \text{ for 4-bladed propellers.} \\ (3.84 \times \text{I. H. P.}) \div (D^2 \times V) \text{ for 2-bladed propellers.} \end{cases}$

(15) P. A. $\div$ D. A. = Projected area ratio for (14) Fig. 9 | 1 | 2 | 3 | (Variable)

(15) = Projected area ratio of the propeller if 3-bladed = Basic.
(16) 4/3 (P. A. $\div$ D. A.) = Total projected area ratio for 4-bladed.
(17) 2/3 (P. A. $\div$ D. A.) = Total projected area ratio for 2-bladed.

| | | | | |
|---|---|---|---|---|
| (18) P. C. = Propulsive coefficient for (15), (16), or (17) | 1 | 2 | 3 | (Variable) |
| (19) E. H. P. = I. H. P. $\times$ P. C. = Basic effective horsepower | 1 | 2 | 3 | (Variable) |
| (20) e. h. p. = E. H. P. $\times$ (e. h. p. $\div$ E. H. P.) = effective horsepower delivered | 1 | 2 | 3 | (Variable) |
| (21) p. c. = Propulsive coefficient expected = $\{n \times (20) \div (1)$ or $(2)\}$ | 1 | 2 | 3 | (Variable) |
| (22) T. S. = Tip speed for (15), Fig. 5 | 1 | 2 | 3 | (Variable) |
| (23) $1 - S = 1 - (9)$ | $(1 - S)$ | $(1 - S)$ | $(1 - S)$ | (Constant) |
| (24) $P = (\pi D \times V \times 101.33) \div (\text{T. S.} \times (1 - S))$ | 1 | 2 | 3 | (Variable) |
| (25) $Z_s$ = Speed factor for $\frac{v}{V}$, Fig. 7, curve 1 | 1 | 2 | 3 | (Variable) |
| (26) $s = (S \times (\text{I. H. P.}_d \text{ or S. H. P.}_d) \times 10Z_s) \div (\text{I. H. P. or S. H. P.})$ | 1 | 2 | 3 | (Variable) |
| (27) $R_d = (v \times 101.33) \div (P \times (1 - s))$ | 1 | 2 | 3 | (Variable) |

If proper revolutions are not obtained, proceed as before.

Attention should be called to one danger that is incurred where I. H. P.$_d$ or S. H. P.$_d$ are used in obtaining the characteristics of a propeller. This danger is produced by an incorrect estimate of $K$. Should the $K$ used be too small the propeller obtained will be too large while the efficiency promised will be greater than will be realized. The propeller will, however, be lifted higher in the safety zone than expected. Should $K$ be too large the opposite results occur.

In many problems that arise the permissible diameter of propeller will be too small to reduce the revolutions under standard conditions of design to so low a number as the problem requires. In such cases it becomes necessary to resort to what may be called a method of reduced diameter.

## PROPELLERS OF REDUCED DIAMETER

There are two of these methods, as follows:

1. Method by changing form of blades to fantail.
2. Method by changing form of blades to broad tip.

By the first method, the propeller, by using the actual effective horsepower to be delivered or a modification of the propelling I. H. P.$_d$ or S. H. P.$_d$ is designed for a larger diameter and lower number of revolutions than specified. The tips are then cut off the blades and the original projected areas retained by widening the blade tips beyond the centers of pressure by an amount of area equal to that cut off from the tips. This method produces higher pitches, considerably lower revolutions and slightly less efficiency than the standard method of design and must be used when the reduction in revolutions is considerable.

By the second method the propeller is designed for a greater diameter than can be carried using a higher effective or engine power than required for the ship. The tips are then cut off the blades reducing them to the diameter allowed.

This method maintains practically constant efficiency with the basic full diameter propeller with a higher pitch and lower revolutions than would be obtained by the regular method of design but the revolutions are not decreased to the same extent as by the first method of reduction.

## FORMULAS FOR REDUCED DIAMETER

FORM 1: FANTAIL

| | | | | |
|---|---|---|---|---|
| (1) $D$ = Diameter possible | D | D | D | (Constant) |
| (2) $D_1$ = Assumed diameter > D | 1 | 2 | 3 | (Variable) |
| (3) $D_1 \div D$ | 1 | 2 | 3 | (Variable) |
| (4) $(D_1 \div D)^{1/2}$ | 1 | 2 | 3 | (Variable) |
| (5) e. h. p. (effective horsepower on one propeller) | e. h. p. | e. h. p. | e. h. p. | (Constant) |

Now proceed as in preceding methods, using $D_1$, until I. H. P.$_d{}^1$ or S. H. P.$_d{}^1$ have been obtained. The actual corrected power will then be

$$\text{I. H. P.}_d \text{ (corrected)} = \text{I. H. P.}_d{}^1 \times \frac{D_1}{D}$$

Use $D_1$ in obtaining the pitch and then proceeding to the apparent slip use the uncorrected value of I. H. P.$_d{}^1$ or S. H. P.$_d{}^1$. Use this slip in obtaining the revolutions for the propeller with diameter $D_1$ then corrected revolutions equal

$$R_d \text{ (corrected)} = R_d{}^1 \times \left(\frac{D_1}{D}\right)^{\frac{1}{2}}$$

When the basis of design is engine power instead of effective the power must be reduced as follows:

$$\text{I. H. P.}_d{}^1 = \text{engine power} \times \left(\frac{D}{D_1}\right)$$

FORM 2: BROAD TIP

| | | | | |
|---|---|---|---|---|
| (1) $D$ = Diameter possible | D | D | D | (Constant) |
| (2) $D_1$ = Assumed diameter > D | 1 | 2 | 3 | (Variable) |
| (3) $(D_1 \div D)^2$ | 1 | 2 | 3 | (Variable) |
| (4) $(D_1 \div D)^{1/4}$ | 1 | 2 | 3 | (Variable) |
| (5) e. h. p.$_1$ = e. h. p. (actual $\times$ $(D_1 \div D)^2$) | 1 | 2 | 3 | (Variable) |

Use $D_1$ and e. h. p.$_1$ in designing the full diameter propeller. Calling the speed of ship $v$, then by the regular method of design, using e. h. p.$_1$ for $v$, the derived power for the full diameter propeller required for the speed $v$ will be I. H. P.$_{d_1}$ and the actual power required for the reduced diameter propeller will be

$$\text{I. H. P.}_d = \text{I. H. P.}_{d_1} \times \left(\frac{D_1}{D}\right)^2$$

The actual revolutions will be

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$R_d = R_{d_1}$ (estimated revolutions, full diameter) $\times \left(\frac{D_1}{D}\right)^{\frac{1}{4}}$

Where the engine power forms the basis of the design this power should be multiplied by $\left(\frac{D_1}{D}\right)^2$ for the power to use in obtaining the full diameter screw.

Such broad tip propellers have one peculiarity, so far as can be ascertained, and that is encountered when they are used on submarines having slips of the first order:

When running on the surface the revolution correcter is $\left(\frac{D_1}{D}\right)^{\frac{1}{4}}$ as given above. When running submerged and plotting below curve B, Fig. 8, this factor changes to $\left(\frac{D_1}{D}\right)^{\frac{1}{2}}$

## CONCLUSION

The paper as submitted embraces the results of many years of study by the author so far as what may be considered orthodox forms of hulls with orthodox propeller conditions are concerned. The questions of small diameter propellers carried as deeply as possible in the cases of deep draft vessels, propellers for double enders, propellers for tunnel boats, etc., have not been touched. All of these various problems require special study to determine the particular values of $K$ and of $S$ to use in the designs of the propellers.

The problems involved in so recording the results and conclusions of years of study and experience in such a manner that all may readily make use of them have not been easy ones and even in the final results as submitted there are ranges of indefiniteness which the author, due to lack of reliable data, has no means of clearing up as they should be cleared up.

Several of these regions of indefiniteness are the determination of the ranges of fineness of hulls covering the transition from hulls of type 2 to those of type 1 and from those of type 1 to those of type 3, also the slight range of speed fraction values at the curve B, Fig. 8, in which the apparent slips pass from slips of the first order to those of the second.

Commander McEntee, with his hull models driven by model propellers, has provided a means by which some of the problems may be solved and by which, when propellers are designed in the safety zones, the true values of $K$ may be obtained, but it is stated that this method of Commander McEntee's is of no use in the cavitation ranges although the author does not agree with this statement where dispersal of the thrust column occurs.

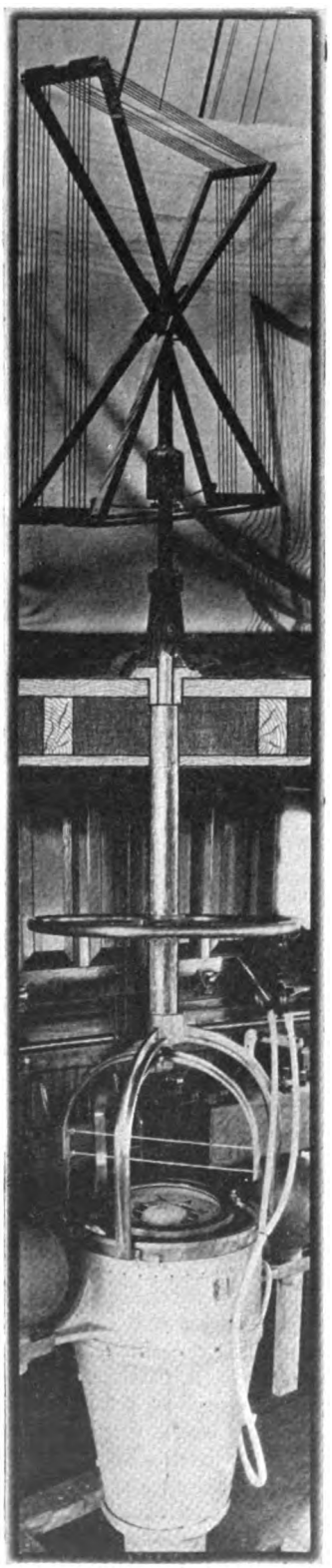
## PROBLEMS OF THE FUTURE

For a complete solution and accurate representation of the phenomena that occur it is necessary to look to the future, trusting that it will bring with it a vast amount of performance data of sufficient value that it can be used with confidence and the complete life history of the hull with its propeller plotted in such a manner as to provide an infallible guide to success in the solution of later problems regarding the propulsion of ships.

It is hoped that the material which has been opened up for inspection will thoroughly impress the student with the fact that the hull with its propeller must be treated in conjunction in the solution of the problem of propulsion. To treat of the propeller without its accompanying hull is to lose time in the ultimate complete solution of the problem involved. The perfect solution of the "Problem of the Hull and its Screw Propeller" rests in the hands of the shipowners, naval architects and marine engineers and without their hearty and intelligent cooperation in the future the problem may never be entirely solved.

# The Radio Compass on Ship Board

THE method of radio direction finding, or radio fog signals, which has been developed by the United States Lighthouse Service and the Bureau of Standards, is based on the peculiar properties of the so-called "coil aerial" when used for the reception of radio signals. This coil consists of about 10 turns of insulated copper wire upon a rotatable frame approximately four feet square. When the plane of the coil is parallel to the direction from which a radio signal emanates, the intensity of the signal received will be a maximum. As the coil is revolved, the intensity of the signal diminishes until a minimum is reached when the plane of the coil comes to a position at right angles to the line of direction from the signal. This minimum, which is well defined, may be determined with sufficient accuracy for navigational purposes, and is used in taking radio bearings.



Radio Compass Installation

The coil aerial mounted upon a vertical spindle provided with a pointer, and a graduated circle below the pointer for determining the position of the coil with respect to a known direction, constitutes what is known as the radio compass or radio direction finder. This apparatus, and the necessary radio receiving device, are installed on the vessel, preferably in a position easily accessible to the navigator.

In the installations which have been made on lighthouse tenders, the coil is mounted on the roof of the pilot house. The spindle extends through the roof and is provided with a hand wheel for rotating the coil. The lower end of the spindle terminates directly above the center of a standard ship's binnacle and carries a pointer so arranged that the position of the coil may be read directly upon the compass card, thus giving the magnetic bearing of the radio signal station at a glance, when the minimum point is reached.

After the radio direction finder has been installed on the vessel, a careful calibration is necessary to eliminate errors caused by distortion of the radio signal by the vessel itself. Simultaneous radio bearings and sight shots with an azimuth circle are taken on a con-

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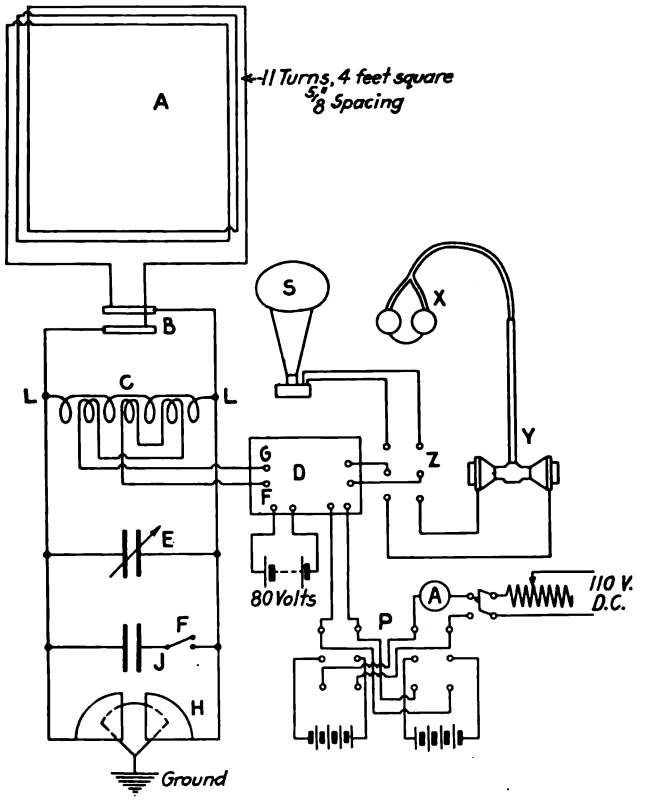
venient radio signal station at intervals of approximately five degrees while the vessel is swung several times in a complete circle. The deviation of the radio bearing from the true bearing is thus obtained for all positions of the coil with respect to the ship's axis. These corrections are then recorded on a circular frame of metal attached to the top of the binnacle and surrounding the magnetic compass, and applied to all subsequent readings of the radio direction finder.

The ordinary telephone receivers, if used by the operator of the direction finder, by reason of their close proximity to the magnetic compass, would cause a deflection of the needle. This difficulty is overcome by installing a special receiver at some distance from the magnetic compass, and conducting




**Circuit for Radio Direction Finder**

the sound therefrom to the operator by means of rubber tubing.

In order to obtain satisfactory results from radio compass navigation, it is essential that the compass be properly constructed, installed and calibrated, and that only receivers and amplifiers of the special type required be used in connection therewith. Until commercial apparatus of this nature has been standardized and tested, care should be exercised to avoid the installation of compasses of improper design. The Bureau of Standards is now preparing a standard specification for this purpose.

Precaution must be taken by the navigator in applying bearings taken at any considerable distance to ordinary navigation charts on the mercator projection, as the line of bearing on such a chart is not a straight line excepting in the meridian.

### FOG SIGNAL STATIONS ESTABLISHED

Three stations for sending radio fog signals are now in commission, Ambrose Channel Light Vessel, Fire Island Light Vessel and Sea Girt (N. J.) Light Station. These stations were selected so as to enable vessels approaching or leaving New York to locate themselves conveniently by cross bearings. The stations are identified by the characteristics of the signals, thus Ambrose Channel sends one dash, Fire Island a group of two dashes, and Sea Girt a group of three dashes, with brief intervals between the groups. The particular lighthouse on which a radio bearing is being taken in a fog is by this means just as definitely known as is the light on which a sight bearing is taken by the navigator of a ship identified by its order of flashes or color. The radio fog signals will be repeated so long as fog or thick weather lasts, and perhaps will be sent at certain specified times in clear weather to permit testing of radio compasses.

### FUTURE DEVELOPMENT

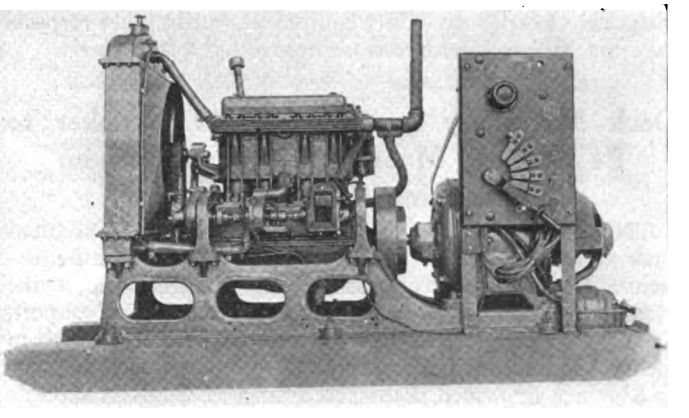
After a reasonable service test of the present group of stations in the vicinity of New York, the Lighthouse Service proposes, as means are available and needs are developed, to install similar groups in the vicinity of important entrances on the Atlantic and Pacific coasts of the country and on the Great Lakes, as well as on some of the principal intermediate capes and light vessels. For the successful utilization of the system, it is of course indispensable that the more valuable vessels at least be equipped with radio compasses, and it is believed that the additional safeguards resulting from such equipment will bring this about, particularly in view of the growing familiarity with the value of radio apparatus to shipping.

As a result of further investigation still in progress by the services mentioned and others, and of actual test and experience, it is expected there will be improvements in this system, and further applications of radio signalling for the safeguarding of navigation. It is not probable, however, that as a result of anything now in sight, the extensive system of sound fog signals, such as sirens, whistles, horns and bells, can be dispensed with, as these are of great value to vessels and boats of every size and description, many of which are not likely to be equipped for receiving radio signals; and furthermore, these furnish warning signals, the use of which is not dependent on the operation of any instrument other than the human ear.

## Gas Engine Driven Arc Welding Units for Intermittent and Heavy Duty

TWO new types of gas engine driven arc welding sets, one for medium or intermittent duty, the other for heavy duty, have been designed by the General Electric Company, Schenectady, N. Y. These units are specially adapted to marine and industrial plants where work to be done is located in out of the way places and is not sufficient to warrant the installation of permanent equipment.

The medium duty equipment was designed particularly for intermittent duty. The generating unit consists of a type "W-D" 10-4 kilowatt, 1,200 revolutions per minute, 60/20 volt 200 ampere generator directly connected by a



**Medium Duty Welding Set**

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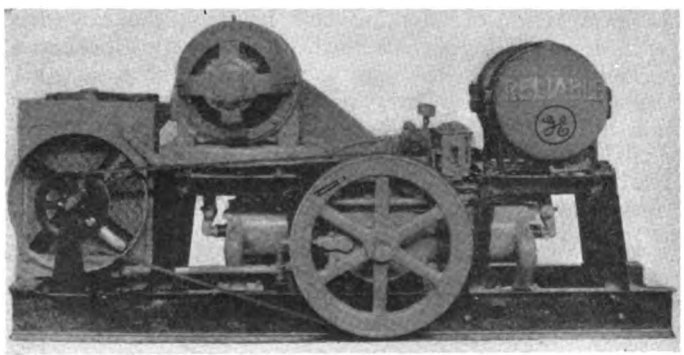
flexible coupling to a Matthews, Model F, 4 cylinder, 4 cycle, 20 horsepower gasoline engine. The engine, radiator, generator and welding panel are assembled on a rigid cast iron base, which in turn is mounted on wooden skids. The set is 86 inches long, 28 inches wide, and has a net weight of about 2,000 pounds. The gas engine used with this outfit has been especially adapted to the requirements of intermittent welding service. It is of the overhead valve type, having cylinders cast in a block with the upper half of the crank case. The lubrication is a combination of splash and forced feed, and the cooling a thermo-siphon system.

The generator is self exciting and regulating, giving practically constant energy throughout the working range. It gives a no-load, or striking, voltage of 60 which automatically decreases to the proper welding voltage (usually 18 to 20 volts) when the arc is struck. It is driven at a speed of 1,200 revolutions per minute, has a normal output of 4 kilowatts and delivers a maximum working current of 200 amperes. The panel carries the generator field rheostat and series field dial switch by which the current can be adjusted from 200 to 75 amperes in 25 ampere steps. A reactor choke coil mounted on the set and connected in the welding circuit protects the generator from current surges.

### Heavy Duty Welding Set

The heavy duty equipment can be arranged to supply either one or two welding circuits. It consists ordinarily of a 20 horsepower 2 cylinder opposed Reliable Heer, Model 00,




**Heavy Duty Welding Equipment**

gas engine, a type "WD"-9 generator and welding panel, the whole mounted on a welded structural steel base with a net weight of 2,400 pounds for the single operator equipment and 3,200 pounds for the double operator unit.

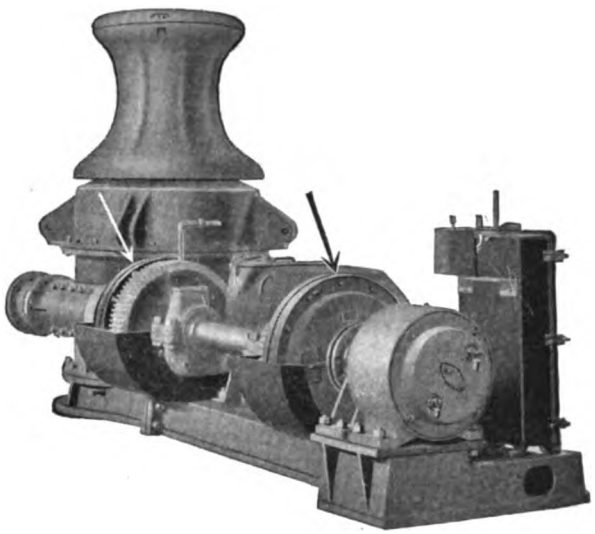
The generator is driven by a silent chain running in oil, and except for the speed its characteristics are similar to the "WD"-10 which forms part of the medium duty outfits. These generators run at 1,750 revolutions per minute, and differ somewhat in the windings because of the difference in speed and service requirements. An ammeter is mounted on the panel of each heavy duty equipment, but in other respects they are identical with the medium duty sets.

## Deck Machinery for Standard Oil Tanker to Be Built at Moore Plant of Bethlehem Shipbuilding Corporation, Ltd.

The deck machinery for the 2,650-ton Standard Oil Company tanker, contract for which has been awarded the Bethlehem Shipbuilding Corporation, Ltd., will be built at the Moore plant of the Bethlehem Corporation, at Elizabethport, N. J., and will consist of a 7-inch by 7-inch Bethlehem spring quadrant type steering gear with horizontal engines, an 8¼-inch by 8-inch Bethlehem spur-gear windlass suitable for taking 1¾-inch anchor chain and a 6¼-inch by 8-inch Bethlehem steam self-contained gypsy.

## Dry Dock Capstan Designed for Heavy Loads

A DRY dock capstan of the reversible, gypsy head type has recently been developed by the Wellman-Seaver-Morgan Company, Cleveland, Ohio, for general dry dock use. The machine is designed to handle rope loads of 30,000 pounds at 30 feet per minute, 10,000 pounds at 90 feet per minute, and 1,000 pounds at 200 feet per minute.



**Two-Speed Dry Dock Capstan Built for United States Bureau of Yards and Docks**

The vertical barrel of the capstan is electrically driven through a worm and gear, and through two speed reductions of spur gears which make possible the load speeds given above. The speed gears are engaged by two C-H magnetic clutches produced by the Cutler Hammer Manufacturing Company, Milwaukee, Wis. These are in turn operated by a selective switch arrangement. Intermediate speeds are obtained by operating on resistance points of the controller.

The capstan barrel and operating mechanism are mounted on a heavy cast iron bed plate, the entire mechanism forming a self-contained unit. The driving motor is of the direct current, series wound mill type totally enclosed and splash proof, operating at 230 volts and having a continuous rating of 40 horsepower and an intermittent rating of 65 horsepower. The two C-H magnetic clutches used to obtain the speed reductions are each 28 inches in diameter and have a pull-out torque of 3,920 pound feet. One clutch connects the motor with the proper gearing to provide the slow speed and the other with suitable gearing for high speed. When the current passes through the magnetic clutch coil, the clutch is engaged and as soon as the current through the coil is broken the clutch immediately becomes disengaged. This is accomplished by mounting one of the clutch members on a spring plate or circular steel disk. When the clutch is energized the two parts are drawn together and the spring plate becomes slightly dished. When the clutch is de-energized the plate springs back flat again and draws the two members apart. The capstan is equipped with a C-H reversible drum type controller enclosed in a waterproof case and having the operating shaft extending through the pit cover. The outer end of the motor jack shaft is provided with a C-H electrically operated disk brake fully enclosed and waterproof.

This type capstan has been adopted by the United States Navy for the navy yard dry docks at Norfolk, Va., and Philadelphia, Pa. The Commonwealth of Massachusetts has also installed one of these capstans in the dry dock at South Boston.

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# Lubrication of Marine Diesel Engines

By Louis R. Ford*

*The chief difference between the lubrication systems on Diesel engines designed for service on land and the marine type Diesel is the almost universal application to the latter type of the principle of forced feed of lubricant to the surfaces to be lubricated and the more common use of gravity and wick feed oiling system on the former. Isolated cases of builders who still cling to the old gravity and wick feed systems may be found in marine practice but in the majority of installations all of the more important bearings are fitted for forced oil feed and only the small bearings, in which the pressures and the rubbing speeds are low, are oiled by wick, drip or hand feed.*

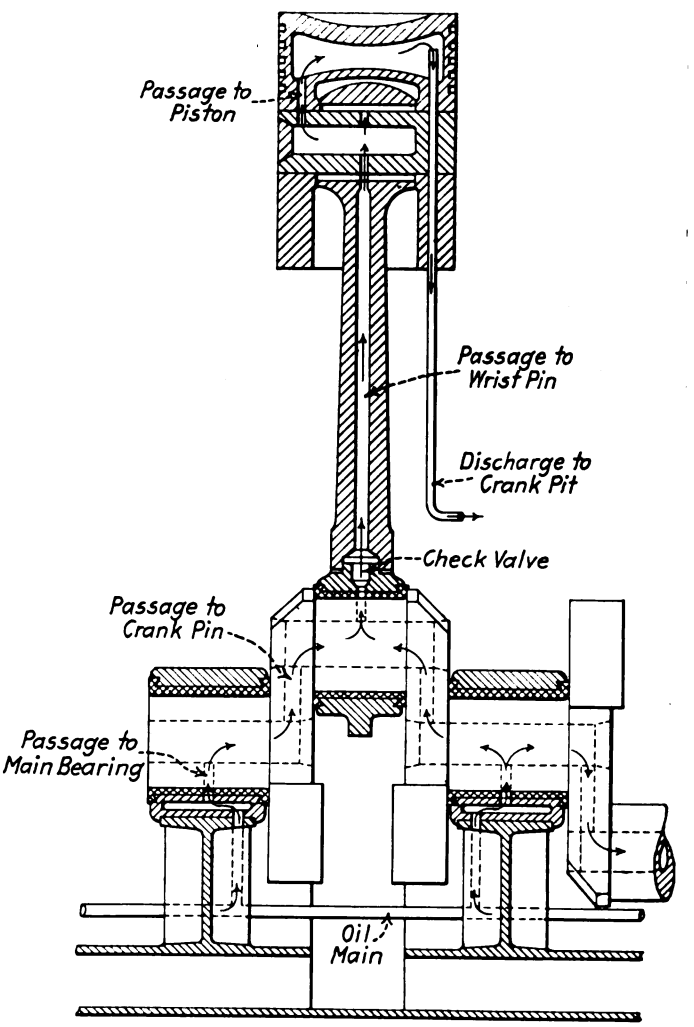
THE design of lubricating systems has become so nearly standardized that practically all builders of marine Diesel engines use the same general arrangement and only in minor details does its application to different engines vary. The main bearings, crank pins, crosshead pins, crosshead guides, cam shaft drive gears and thrust bearing are supplied with oil through the low pressure system, in which the same oil is used over and over. For the power cylinders and air compressor cylinders a separate high pressure system is used and it differs from the low pressure system in that the oil cannot be recovered after it is once applied to the rubbing surfaces to be lubricated.

In the low pressure system each of the bearings served is supplied with a large excess of oil over the amount required for adequate lubrication, the oil being forced into the bearings under sufficient pressure to cause it to spread over the entire surface of each bearing, and the excess flows out through the ends of the bearings. About the only definite requirement as to the quantity of oil that must be circulated through the low pressure system is that it must be sufficient to maintain a constant flow through all the oil passages to the various bearings, but the excess over actual lubrication requirements should be quite large in order to prevent drainage of any branch of the system through a bearing that may develop too much clearance. It should be borne in mind, however, that the larger the amount of oil circulated the greater will be the power consumption by the pump. From one and a half to two gallons per brake horsepower per hour will be found sufficient.

### Course of Oil in Low Pressure System

The working supply of oil for the low pressure system is carried in a sump tank located in the double bottom just aft of the engine. The lubricating oil circulating pump draws the oil from this tank and discharges it through a cooler to the distribution system on the engine. A large oil main runs fore and aft, parallel to the engine bed, with a branch pipe leading to each main bearing and to the thrust bearings, cam shaft drive gears, or to any other special points to which it may be desirable to apply oil under pressure. The branch pipe to each main bearing is usually carried into the journal from the top, for the reason that more clear space is available there. A better arrangement is to bring the pipe in through the bottom of the journal, so that the oil may be forced between the shaft and the bottom bearing shell while the shaft is at rest, but this is somewhat difficult because of the small clearance between crank web and the cross member that carries the main bearing. A circumferential groove in each main bearing shell registers with a radial hole in the crank shaft and the oil flows through this groove and hole to an axial hole in the shaft, thence through a hole in the crank web to an axial hole in the crank pin and into the crank pin bearing through a radial hole in the pin. This radial hole registers with a circumferential groove in the crank pin boxes through which the oil flows into an axial hole in the connecting rod and up to the crosshead pin bearings or the piston pin.

In the case of crosshead type engines a portion of the oil flows from the crosshead pins through a hole to the crosshead guide. From the crosshead guide and the crosshead pins the oil discharges into the crank pit and drains by gravity back to the sump tank. In some trunk piston engines part of the oil that goes to the piston pin bearing flows through suitable passages into the piston, for the purpose of cooling the piston, and discharges from the piston to the crank pit.




**Course of Lubricating Oil Through Trunk Piston Engine**

### Straining Out Impurities

The end of the suction pipe in the sump tank should be fitted with a strainer to prevent entry of rags, waste or other

*Worthington Pump and Machinery Corporation, New York.



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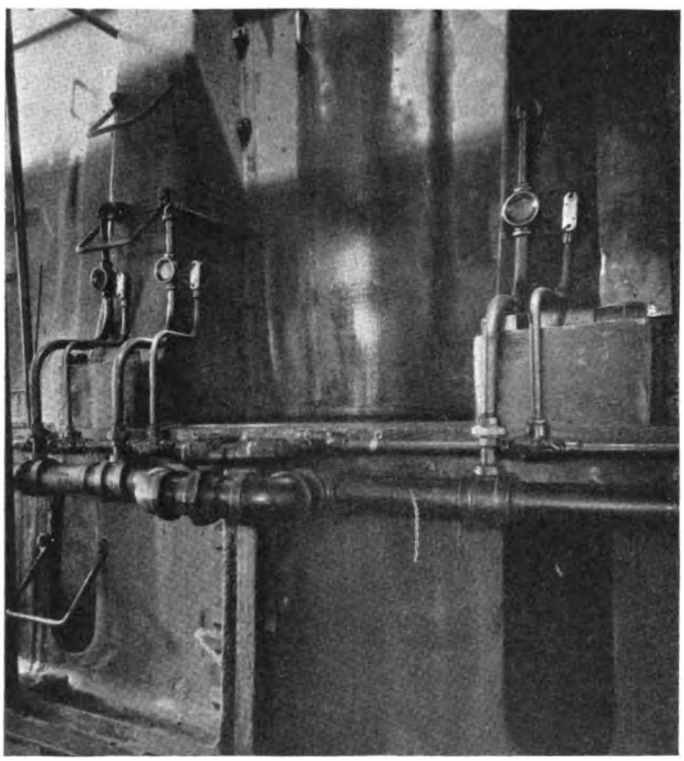
foreign matter into the suction pipe and a second strainer should be placed in the discharge line of the pump. This latter strainer should be of the duplex type, so arranged that one side can be opened up for cleaning without interfering with the operation of the other side, and with the strainer elements made in the form of baskets of fine wire gauze. As an additional precaution against clogging up the system each of the openings in the crank pits through which the oil drains to the sump tank should be covered with a perforated plate.

It is almost impossible to prevent some trash from falling into the crank pits during overhaul of the engine, and in spite of the most vigilant supervision it will sometimes happen that the pits are not thoroughly cleaned out before the engine is closed up. These various strainers take care of only such matter as may clog up the system and are not intended for



**Example of Arrangement of Oil Supply Main with Branches to Main Bearings and Electric Flow Indicators in Each Branch**

oil purification or the removal of suspended matter. This is the function of the filter or separator, which will be discussed later.

Owing to the fact that there will nearly always be some variation in the clearances of the various bearings, and the clearance regulates the amount of oil that will flow through the bearing and out of the ends, there will be some variation in the amount of oil taken from the main by each of the branch pipes that lead to the main bearings. This will cause a variation in the pressure in the different parts of the system, so that some of the bearings at the ends of the lines, particularly the crosshead pin bearings, may not get as much oil as the others.

### CORRECTING UNEQUAL DISTRIBUTION

This unequal distribution may be corrected by placing some sort of restriction in each of the pipes leading to the main bearings, such as a washer or plug with a small hole drilled in it, thus permitting only as much oil to flow into each pipe as will pass through the restriction. In addition to this the oil discharge line from the circulating pump should connect to the oil main at the center of its length rather than at one end. This arrangement insures the group of bearings under each cylinder getting the same amount of oil but the equal distribution of oil to each of the bearings in each group depends upon the correct proportioning of the oil passages and the maintenance of correct clearances in the bearings.

The clearance of main bearings is particularly important in this connection; these bearings will run noiselessly with considerable clearance and, without giving any indication of their looseness, they may allow so much oil to flow out of the ends that not enough will reach the crank pins and crosshead pins. Little if any grooving of bearing surfaces should be done where forced lubrication is used; usually one longitudinal groove at the point of greatest pressure in each bearing being sufficient to distribute the oil.

The fitting of shims between the faces of the bearing boxes should receive very careful attention. The edges of the shims abutting on the shaft or pin must be cut well back so that they will not interfere with the flow of oil around the bearing, but this relieving must not be carried out to the ends of the shims, otherwise large holes will be formed at the ends of the bearings and so much oil will flow out through them that normal pressure cannot be kept in the system.

It may sometimes happen that a good flow of oil is obtained through all bearings when the oil circulating pump is operated while the engine is not in operation but the supply to the crosshead pin bearings or piston pin bearing is insufficient when the engine is running. This may be due to the inertia effect of the oil in the connecting rod, whereby the oil is forced down out of the rod when the rod suddenly changes its direction of motion as it passes bottom center. This effect is most noticeable in high speed engines. On the United States submarines this trouble was corrected by placing a simple ball check valve in the bottom of each connecting rod. This check valve promotes circulation of oil for the reason that when the rod moves upward the oil in the central passage is accelerated, the velocity thus built up assists the pump pressure after the rod passes top center and starts on the down stroke, and acceleration in the downward direction that would force the oil back against the pump pressure is prevented by the valve.

### WHY A TIGHTLY CLOSED-IN ENGINE HOUSING IS ESSENTIAL

When the engine is in operation the oil flowing out of the rotating and reciprocating bearings is dashed in all directions, and every part of the interior of the housing is filled with a heavy oil mist or spray. Unless the housing is very tightly enclosed a large quantity of oil is thrown out of the engine and lost in the bilge. A tight housing is essential not only from the standpoint of economy but also from that of safety and "liveableness" in the engine room. An open housing engine with forced lubrication results in a most uncomfortable engine room, and oil covered ladders and floor plates offer very precarious footing in a seaway. Engines of the trunk piston type, as ordinarily constructed, require no special precautions against loss of oil by splashing out of the housing but in order to prevent a large amount of bearing oil being burned in the cylinders it is good practice to fit splash hoods over each crank. These hoods are made in sections and bolted to the cross members that carry the main bearings. In spite of the most careful precautions against splashing some of the bearing oil will work into the cylinders of the trunk piston engine.

The housings of crosshead type engines are closed by fitting sheet steel or cast iron plates between the frames, these plates being drawn down on cork or canvas gaskets to prevent leakage around the edges. The ease with which the oil searches out minute cracks or small openings left when fitting the splash plates is surprising and when an engine is placed in service it may be necessary to calk packing into such

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openings to prevent a large waste of oil. If the design of an engine provides a closed partition between the lower ends of cylinders and the crank cases, so that no oil is lost by being carried into the power cylinders, there should, theoretically, be no loss of oil and it should not be necessary to add any additional oil until the supply in the system has been so contaminated as to render it unfit for further use; actually, however, some oil is lost by leakage at various points and the amount of make-up required depends upon the amount of care exercised in stopping small leaks in the engine housing, oil piping, pumps, strainers, etc. Even under the best conditions the loss by leakage may amount to about six quarts per day in a large engine.

An objection frequently raised against the tightly closed-in housing is the impossibility of observing and feeling the bearings. In attempting to meet this objection some builders resort to various devices such as electric flow indicators placed in the branch pipes to the main bearings; thermometers placed in the main bearing boxes, with temperature indicating scale at the operating platform; circumferential grooves in the ends of the main bearings to watch the overflow and conduct it through pipes to a point near a door in each splash plate through which the temperature of the oil flowing out of the pipes may be felt with the hand. Each of these devices has the defect that it does not give an indication of the condition of the crank pin and crosshead bearings, which are the bearings most likely to overheat. As a matter of fact, if the proper precautions regarding fitting of shims, testing out the entire lubricating system before getting under way, maintaining correct oil pressure and keeping the oil clean are observed, overheated bearings will be so rare that the engineer will cease to worry about their being out of sight.

The temperature of the oil in the return flow pipe from the crank pit should be closely observed as any overheating of bearings would be indicated by an abnormal rise in this temperature. In engines with the cylinders partitioned off from the housing and with a separate cooling system for the pistons the temperature of the oil returning from the crank pits should be only very slightly higher than that of the entering oil and the use of an oil cooler becomes unnecessary. In the trunk piston engines, however, the oil becomes heated by being splashed against the hot pistons and by contact with hot gases that sometimes leak past the pistons, so for this type an oil cooler is necessary. If the pistons are cooled by circulating lubricating oil through them this oil may be discharged into the crank pit when it mingles with the bearing oil and, of course, raises its temperature and requires the use of a cooler.

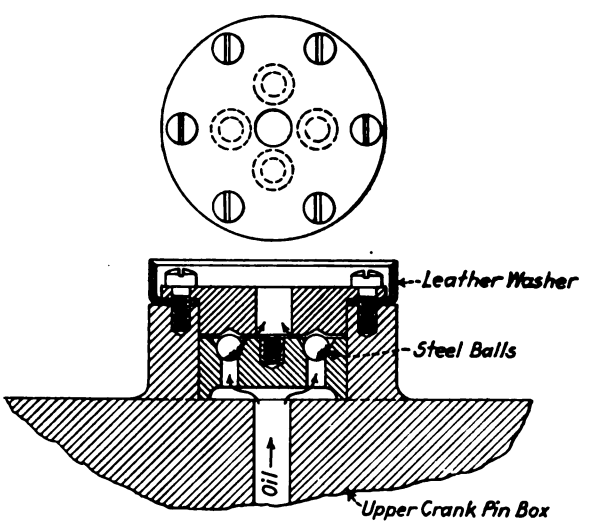
The oil cooler may be of either the straight tube or coil type and the cooling effect is obtained by circulating sea water through the cooler. For this reason the oil must be tested frequently for chlorine, the presence of which indicates that salt water is leaking into the oil, the most probable location of the leak being in the cooler. It should be remembered, however, that this salt water may enter the system from the bilge, through a defective manhole gasket on the sump tank.

### Trouble from Water or Carbon in the Oil

By far the greater part of the lubrication difficulties with Diesel engines have been caused by water or carbon in the oil. For pistons above 20 inches diameter some form of cooling must be used. Because of its superior heat absorption characteristic, water is the most desirable cooling medium, and because it is available in unlimited quantity, sea water is the logical choice for marine engines. Its use, however, is restricted to engines in which the designer has eliminated all possibility of water leakage into the crank pits, because even the best lubricating oils will emulsify when salt water is added and the emulsion thus formed will clog up the lubricating system. For this reason many designers prefer to use fresh water for cooling the pistons, so that any small amount of leakage from the joints of the piston cooling system will do no serious damage.

Even with the fresh water system some trouble will be experienced, if the water gets into the oil, for an emulsion will in time be formed, though this emulsion can be broken down and the oil and water separated. In this connection it is interesting to note that this emulsion is very difficult to break down, if it contains oxide of iron. For this reason all the metal parts inside the housing should be kept free from rust. This leads to some designers using a portion of the lubricating oil for cooling the pistons. With this arrangement lubrication troubles are sometimes caused by carbonized oil flaking off from the interior of the pistons and mingling with the oil in sufficient quantity to clog small passages in the lubricating system. The tendency to carbon formation on the underside of the piston top is greatly reduced, if the cooling oil is given a high velocity through the piston.

In trunk piston engines a great deal of carbon and so called "black oil" from the cylinders will work past the piston rings into the crank pits and mix with the lubricating oil. This cylinder carbon interferes with lubrication both by retarding circulation in the system and by reducing the lubricating qualities of the oil. Although it is commonly referred to as carbon it actually consists of a mixture of carbon, metal dust and other impurities, such as sodium sulphide, that may be deposited out of insufficiently washed fuel oil.




**Check Valve Placed in Upper Crank Pin Box Oil Passage to Connecting Rod**

### Oil Filters

It is customary to include some sort of filter in the low pressure lubricating system, and the connections are so arranged that continuous filtering may be carried on or a portion of the oil may be taken out of circulation and filtered then returned to the system. In these filters the oil is usually heated, then passed through muslin, flannel, felt or fullers earth, and in some cases separate compartments are provided in which the oil may be treated with chemical reagents for the removal of suspended carbon. A comparatively recent development in this line is the centrifugal separator which utilizes the difference in specific gravities of the oil and any foreign matter contained therein to cause separation by centrifugal force in a whirling chamber. A simple method of removing water from the oil is to provide a tank in which a portion of the oil may be allowed to stand without agitation so that the water will settle to the bottom. Rapid separation of water is promoted, if a steam coil is placed in this tank

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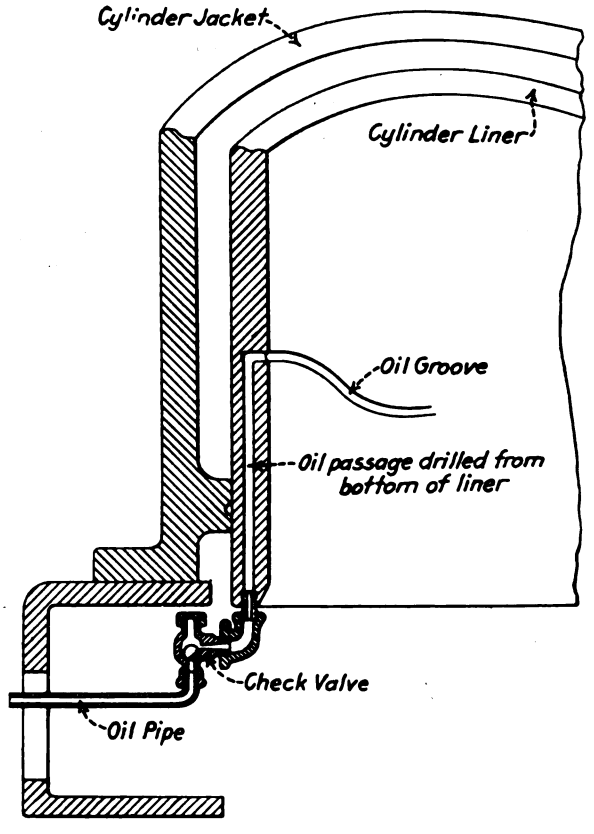
for heating the oil. If the ship lies in port any considerable length of time and the oil in the sump tank is not disturbed, the water contained in the system will settle to the bottom of the tank. For this reason a pump connection at the bottom of the sump tank should be provided so that this water may be pumped out before the lubricating oil circulating pump is started. This connection will be found useful in case a large water leak develops while under way at sea, to prevent water accumulating in the sump tank in sufficient quantity to raise the oil above the circulating pump suction.

For drainage of oil from the crank pits to sump tank a hole is usually provided in the bottom of each crank pit, connecting with a fore and aft duct cast in the under side of




**Method of Attaching Oil Pipe to Liner Without Entering Water Jacket Space**

the bed or with a pipe main flanged to the bed. The best method of applying strainers to these openings is to cast a pocket in the bottom of each crank pit and cover the pocket with a perforated plate.

### HIGH PRESSURE LUBRICATING SYSTEM

The high pressure lubricating system supplies oil to the power cylinders and air compressor cylinders and consists essentially of a number of multiple unit pumps, commonly referred to as mechanical oilers, and the necessary pipe leads to the points of application of the oil. The usual form of mechanical oiler is a group of pumps mounted in an oil reservoir, the pumps receiving their motion through an eccentric or gear connection to some rotating part of the engine, usually the cam shaft, and the number of pumps in one oiler may vary from one to twenty-four, depending on the number of points to which oil may be applied simultaneously. Each pump is a double unit and so arranged that the first pump in the unit draws oil from the reservoir and delivers it into the suction of the second pump which in turn delivers it to the point to be lubricated. The amount of oil delivered is regulated by throttling the suction of the first pump by means of a hand regulating screw. These mechanical oilers are mounted on the fronts of the engine frames or in some other easily accessible place. A very necessary pump characteristic in any type of mechanical oiler is the ability to handle a very small quantity of oil in one stroke.

The number of inlets to each cylinder, and consequently the number of pumps required for each cylinder, is largely a matter of opinion. Some engines have been built with as many as eight oil pipes entering the cylinders while others operate very successfully with two. In the latter case oil grooves of ample length should be cut in the cylinder liner, extending on both sides of the inlet hole, to distribute the oil. In order to reach the cylinder liner the oil pipe must pass through the jacket water space. For this reason the pipe connection at this point is usually by means of a short tube screwed into the liner and passing through a stuffing box in the cylinder jacket. If this tube is rigidly connected to both liner and jacket, trouble may be experienced due to the expansion of the tube when hot causing it to push against the liner hard enough to deform the liner and cause the piston to jam. This connection even when made up carefully is a source of considerable trouble in service. In the case of large engines where the liner thickness is sufficient and the lower end of the liner is accessible the oil pipe connection may be made at the bottom of the liner, as shown on this page. In this case no expansion difficulties will be experienced, there is no water joint through which water may leak into the cylinder.

### CYLINDER LUBRICATION

The oil hole in the cylinder liner should be so located that when the piston is at the bottom of its stroke the top piston ring is above the hole; if located higher than this, some of the lubricating oil will be deposited on top of the piston where it serves no useful purpose. Were it not for the necessity of discharging the oil into the cylinders at a definite time in the cycle all the lubricators could be grouped into one large unit, with a single operating gear. It is necessary, however, to time the pumps to each cylinder so that the oil will be forced into the cylinder when the piston is at the bottom of its stroke and in four cycle engines this should be at the end of the power stroke so that there will be a minimum of pressure in the cylinder during the time the oil is being spread over the surface of the liner by the movement of the piston.

No definite rule can be stated for the amount of oil required to lubricate any one cylinder other than to say that the condition to be aimed for is a light coating of oil over the entire surface of liners and rings with no carbon or gummed oil in the ring slots. The rate of feed to which the pumps must be adjusted to maintain this condition can be determined only by experience in each particular case, but it should not be necessary to use more than one gallon of oil per ten thousand horsepower hours.

Whenever a cylinder is opened up the lubrication conditions should be carefully observed as a guide to lubricator adjustment. In two cycle engines the surfaces of the liners in the vicinity of the exhaust ports and the bridges between the exhaust ports are most difficult to lubricate owing to the tendency of the exhaust gases to sweep the oil off of these surfaces as they rush out of the ports at high velocity. The metal in this vicinity attains a high heat that tends to interfere with lubrication and this condition is met in some designs by making the exhaust port bridges hollow and passing water through them. This arrangement has a good effect in reducing heat stresses in the structure but its value as an aid to lubrication is negligible since it has no influence on the chief lubrication disturbing factor, the sweeping of oil off the surfaces by the rapidly moving exhaust gases.

In locating the mechanical oilers it is desirable to place them below the level of the oil inlet holes in the cylinders, so that the oil will not drain out of the pipes while the engine is shut down. The pumps deliver very small quantities of oil

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into the pipes per stroke and, if the pipes between pumps and cylinder are empty when the engine is started, the length of time required for the oil to get to the cylinders may be great enough to cause considerable damage to the cylinder liners and rings. If the oil lines to the cylinders have been disconnected at the pumps for any reason while the engine is shut down, the pump operating gear should be disconnected and the pumps operated by hand, before the engine is started, long enough to fill the pipes.

In the case of the trunk piston engines one of the most common troubles is the admission of an excessive amount of oil to the power cylinders due to the oil spray in the housing depositing on the cylinder walls and pistons. It has been found in recent years that with the engines of this type the mechanical lubricators may be dispensed with and dependence placed on the oil spray for lubricating the cylinders. The highly successful German submarine engines are not equipped with mechanical lubricators for the power cylinders.

### LUBRICATION OF AIR COMPRESSOR CYLINDERS

The air compressor cylinders are lubricated by mechanical oilers similar to the ones used for the power cylinders, but the pumps should be adapted to handle a smaller quantity of oil per stroke than is the case with the power cylinder lubricators. Not only is less oil per stroke required for adequate lubrication of the compressor cylinders but there are two other important reasons for reducing this oil supply to a minimum. The moisture contained in the air forms an emulsion with the oil and if an excessive amount is supplied, this emulsion will form a jelly that will clog piping and valves and interfere with the spraying of fuel into the power cylinders. With excessive oil supply to the compressors there is the ever present danger of an explosion of the mixture of oil vapor and air that may be formed in the high pressure air system. When the air compressor piston is made in the form of a single acting differential piston with the lower end of the cylinder open to the crank case it is customary to place the second stage next to the crank case so that the pressure in the cylinder will tend to prevent oil vapor from the crank case being drawn up into the compressor, but even with this arrangement it will be found that a large amount of oil will sometimes work up into the cylinder, in spite of the pressure. To guard against this a scraper ring should be placed near the bottom end of the piston to scrape the oil off the cylinder wall on the down stroke. This matter of oil in the air compressor and spray air system is one that should receive very serious consideration from the operator and it should be made a rule to steam out the whole air system at least once a year.

### SELECTION OF LUBRICATING OIL

There has been so much written about lubrication from the scientific standpoint and there are so many lubrication hobbies exploited that the marine Diesel operator confronted with the selection of the proper kinds of oil to use is likely to be somewhat puzzled. As a general rule it is safe to accept the recommendation of reliable manufacturers of oils as to the most suitable oils for Diesel engine use, for these companies have given a great deal of expert attention to the production of these oils and their laboratory work has brought out some very interesting facts concerning the behavior of various lubricants under the conditions met in Diesel engine practice. The operator should not, however, depend too much upon the mysterious virtues of some particular brand of oil to solve his lubrication difficulties, but rather give a little intelligent thought to the requirements of his machine and the characteristics of the oil necessary to meet these particular requirements.

Fundamentally the function of a bearing oil is to maintain an unbroken film between the moving surfaces so that there can be no contact between these surfaces. It has been demonstrated experimentally that the metal surfaces in a bearing do not slide upon this film; both surfaces of the film adhere to the metal, so that one surface is stationary while the other is in motion and somewhere between the two the oil is pulling apart and sliding upon itself. The force required to tear this film and permit the two parts to slide upon each other represents the friction load in the bearing and its amount depends upon the viscosity of the oil. From this it follows that the lower the viscosity of the oil, or in other words the more fluid the oil, the less will be the friction and the most fluid oil obtainable will be best lubricant, if we consider only the internal friction of the oil. This conclusion is modified however by the fact that the more fluid the oil is the more easily it is squeezed out from between the bearing surfaces by the pressure on the bearing. It is necessary then to use oil the viscosity of which is high enough to prevent squeezing it out of the bearing.

It may be stated as a general rule that the best oil for any bearing is the lightest oil that will stay in the bearing under the maximum pressure to be expected in that bearing. Theoretically each bearing on the engine should be supplied with the oil best suited to its particular service, but this is impossible, due to the complicated equipment and multiplicity of oils that would be required. Actually the requirements of the major bearings, such as main journals, crosshead pins and crank pins determine the kind of oil to be used throughout the engine, excepting the interior of the cylinders which must be considered separately.

For use in the forced lubrication system a prime requisite is that the oil must not emulsify, when water gets into the system, to a degree that will not permit restoring it to its original state, neither must it foam too much when beaten up in the system and mixed with air. This eliminates vegetable, animal or compounded oils from consideration and necessitates the use of straight mineral oils. The oil must be free from acids that would attack the metal of the bearings and must, of course, contain no solid matter.

For power cylinder lubrication the oil must have a high flash point, over 500 degrees F., to prevent it being burned off the cylinder walls too quickly, must be free from acid and its viscosity should be high enough to make it a good sealing agent between piston rings and cylinder walls. If an engine has been in operation long enough to have badly worn cylinder liners or piston rings, it may be found desirable to use an oil of much higher viscosity than was used while the engine was new. This oil will tend to prevent leakage of gases past the rings. Investigators in England have found that when using fuel oil with a high sulphur content the sulphur reacts on the lubricating oil and causes a sticky deposit in the cylinders.

The conditions to be met inside the air compressor cylinders are, from the standpoint of lubrication, the most difficult of any in the engine. In addition to the heat resisting qualities and piston ring sealing qualities required in the power cylinders the air compressor oil must be able to adhere to the metal surfaces in a very wet medium. A great deal of moisture is deposited out of the air in the compressor and this moisture tends to wash the oil off the cylinder walls. For this reason it is desirable to use an oil that will form an emulsion with the water and stick to the metal. As previously pointed out the emulsified oil is sometimes a cause of considerable trouble in the air system but it is necessary for it to emulsify in order to have any value as a lubricant in the compressor. For this service a compounded oil is desirable.

A great many engineers are partial to clear oils and are inclined to think that an oil with a nice amber color must necessarily have good lubricating qualities. As a matter of fact color and lubricating value have no relation to each other; the normally dark oils are treated in order to lighten their color only because of the general trade preference for the light color.

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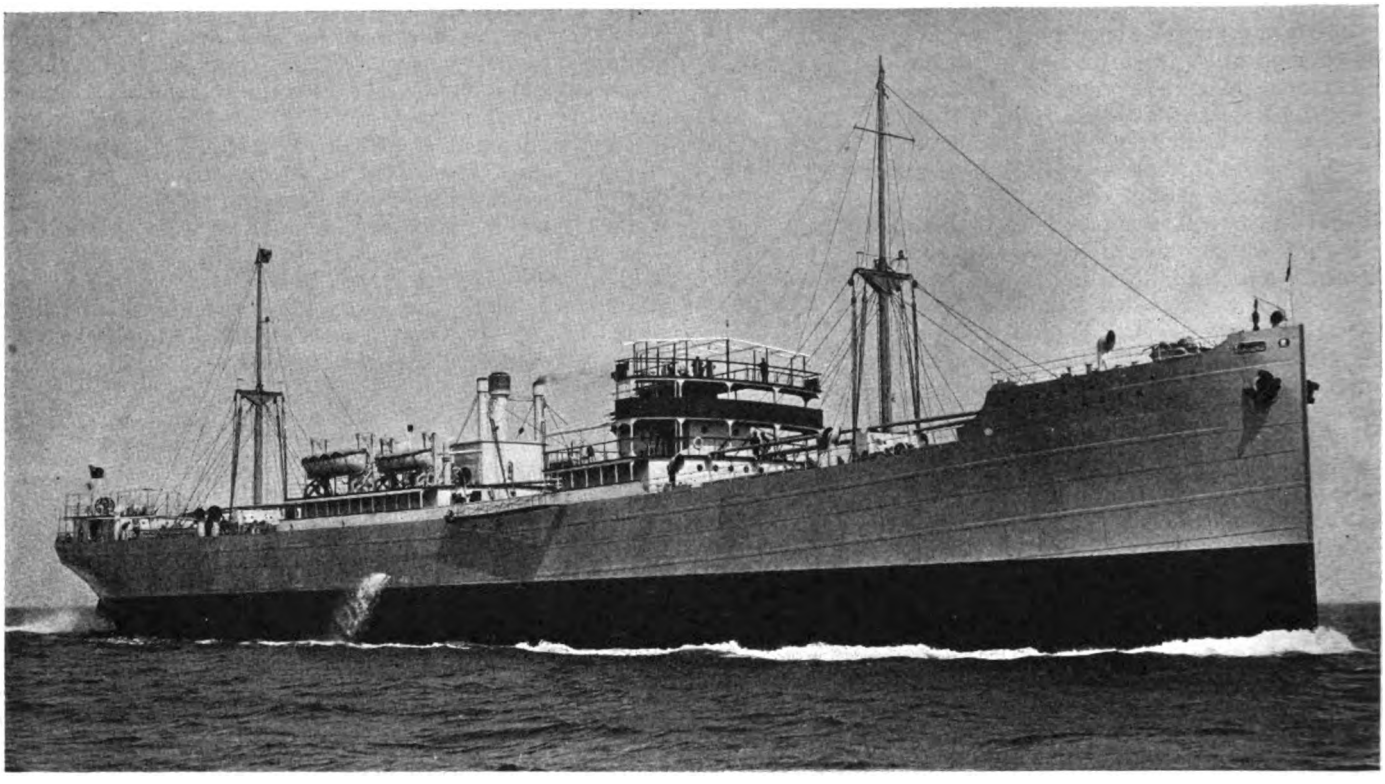

**Motorship Yngaren on Her Sea Trial, June 14, 1921**

# The Motorship Yngaren

**By Our Special London Correspondent**

*No event of recent months has aroused so much interest among the shipping, engineering and shipbuilding community in Great Britain as the trial trip of the motorship Yngaren which was carried out in the middle of June. The reason is that this vessel is the first of a series of standard ships which William Doxford and Sons are building and equipping with their remarkable opposed piston oil engines. The motor in the Yngaren is the highest powered set that has yet been installed in any vessel and the great confidence of builders and owners is indicated by the employment of a single screw installation.*

HITHERTO there has been some hesitation in the adoption of only one engine in a motorship but all fear now appears to be dispelled, and, even in the case of a motor which is the first of its type, shipowners are quite prepared to install only one set and not take advantage of the safeguard afforded by a twin screw arrangement. Naturally there is a good deal to be said for the employment of single screw cargo ships, especially when, as in the case of the *Yngaren* described in this article, the motor runs at what is practically steam engine speed, namely 77 revolutions per minute.

Nothing could illustrate better the real attitude of shipping men and shipowners towards the motorship than the fact that the Doxford type of motor has been designed in such a way that it can be installed in a very large number of existing steamers in replacement of the steam engines. In fact, the *Yngaren* so far as the hull is concerned is a sister vessel to the famous Doxford standard steamships, and it is no secret that the builders hope in the course of time that all the standard vessels which they have built will be converted into motorships fitted with their oil engines.

The *Yngaren* carries 9,350 tons of cargo on a draft of 25 feet 6 inches, being 420 feet in length with a beam of 54 feet and a depth molded of 37 feet. She has been constructed for the Transatlantic Steamship Company of Gothenburg, which is the owner of a number of Burmeister and Wain engined vessels. So convinced are the owners of the success of this type of engine that they have two more vessels under construction, the first of which will be completed in the next few months.

## The Opposed Piston Engine

The propelling engine of the *Yngaren* has already been described in Marine Engineering. The designed output is 3,000 indicated horsepower, and owing to the fact that no air compressor is used and most of the auxiliary pumps are separately driven, the high mechanical efficiency of 90 percent is attained giving a total shaft horsepower of 2,700. As is well known the Doxford engine adopts the opposed piston principle and there are four cylinders, the diameter being 580 millimeters and the stroke of each piston 1,160 millimeters. On the trials it was amply demonstrated that the opposed piston motor possesses definite advantages. The cushioning effect was very notable, giving an almost complete absence of vibration, and the engine is without question the quietest running Diesel motor that has ever been built for marine work.

From the standpoint of the man operating the engine



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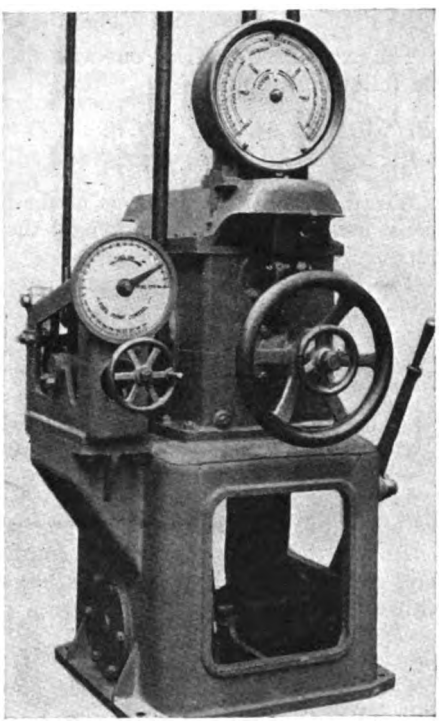
the simplicity of the control is an outstanding feature. As most engineers are aware, on the majority of Diesel engines there are at least two levers or wheels to be used for starting and maneuvering. Often there are three, but in the Doxford opposed piston engine there is merely one, a large hand operated wheel. The engineer has therefore to do nothing more than he would in starting a steam engine. To go in the ahead direction, he turns the wheel to the right, and the more he turns the wheel, the faster the engine runs until full speed is attained. For the astern direction, he merely turns the wheel to the left with the same result. Moreover, the engine does not start off with a rush as is usual but slowly picks up, and if the order comes to go slow ahead, the engineer merely turns the handwheel until he sees the speed counter indicating about 20 revolutions per minute. The engine will then continue to run at this speed as long as is required. It is not necessary in the first place to speed the engine up to the maximum and then bring it down, as is the ordinary method.



**Control Station of Doxford Engine**

The only thing against the engine so far as can at present be judged is that it requires three hours' warming up by steam before it can be started, this being due to the low compression pressure adopted—about 300 pounds per square inch. The solid injection is effected at about 8,000 or 9,000 pounds per square inch and during the trials this seemed to operate perfectly. An arrangement is made whereby, in the event of a failure of the fuel pumps which are driven off the crankshaft, an auxiliary set operated by an electric motor can immediately be brought into action. There is thus little likelihood of any failure arising due to a breakdown of pumps.

### THE AUXILIARIES

Even in the engines used for driving the dynamo Doxfords have employed the same principle as in the main machinery. Three opposed piston oil engines with two cylinders 7 inches in diameter are installed and these also operate on solid injection at 8,000 pounds per square inch. They develop 100 brake horsepower and must have been somewhat difficult sets to design; on the trials they showed some signs of bad governing. However, it is understood that the builders had to produce the engines at very short notice on account of a change of plans and no doubt this small defect will be readily overcome.

### MOTOR "TRAMPS"

Although in some quarters the possibility of America making great strides in connection with motorship development is scouted, this is not the general view as instanced in a recent lecture given by Mr. Barfoed, one of the directors of Burmeister and Wain of Copenhagen. He remarked that he considered American shipowners would very shortly build up a fleet of motor vessels and that with the low price of oil fuel in America these ships would sweep all the European coal fired steamers out of competition. He therefore concluded that the only hope for European steamship owners to meet this fierce competition, which would undoubtedly arise, was for them to convert their steamers to motorships.

Mr. Barfoed also brought forward some very interesting facts in connection with motor tramp ships. He pointed out that although hitherto the Diesel vessel had generally been considered as specially adapted for long voyages and fixed routes, recent developments have shown that it would make an admirable tramp on account of its low fuel consumption with the consequent possibility of carrying sufficient bunkers for a voyage around the whole world. He produced figures relating to some tramp ships which are now being built, showing that the motor vessel could carry freight at a price over 60 percent lower than was possible with a corresponding steamer. This paper has attracted considerable attention in European shipping circles, for the idea of a motor tramp ship is somewhat new and in many respects attractive.

### THE NEW TOSI ENGINE

Hardly a month now passes without some entirely new development in the evolution of the motorship being made. While perhaps chief interest centers round the construction of new types of two cycle Diesel motors there are still some novel four stroke engines being produced and among these none is more interesting or more important than the Tosi design now being constructed in Great Britain by Beardmores.

Their first engine is complete and is now running tests. It develops 1,200 brake horsepower in six cylinders 24⅜ inches diameter and 38⅜ inches stroke and those who have seen it in operation say that it is something very original and promising. It has an entirely new design of fuel valve, eliminates one of the valves in the cylinder cover, leaving only three to be actuated, and is controlled and maneuvered by hand without the use of compressed air. The exhaust gases are discharged from the same valve which admits the atmospheric air on the suction stroke. This is effected by the intermediary of what is called a director semi-rotary valve arranged within a Y-shaped pipe leading from the valve.

There are many other new features in this engine and it is hoped to give a fuller description in the course of a short time.

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## Experiments with Semi-Diesel Engines Using Vegetable Oils as Fuel

**By Commander Eugenio Normand**

SOME interesting experiments have been completed in the Ansaldo San Giorgio Works, at Turin, Italy, where some very successful tests on a semi-Diesel engine were made using certain types of vegetable oils instead of the usual heavy mineral oil.

The engine used in the experiments was a mono-cylinder engine of 20 brake horsepower running at a speed of 400 revolutions per minute. It was taken from stock and it is of the same type that is normally built and sold by Ansaldo San Giorgio.

These engines present the two following remarkable features:

1. No injection of fresh water.
2. Controlled admission of scavenging air.

The injection of water, according to the opinion of some eminent technicians, among whom may be mentioned Professor Eng. R. E. Mathot, of Bruxelles, who assisted in the

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experiments, is a matter that is no longer necessary. This proceeding was only a remedy to a defect of cooling in the combustion chamber and as this defect has been eliminated there is no need for the remedy.

In the engines on which the experiments were made, this elimination was effected by a convenient disposition of the circulating water, which also cooled the cylinder cover. This was accomplished in the cylinder cover by a large oblique canal which connected the interior of the cylinder to the hot bulb fitted directly on the cover. This arrangement prevented the bulb from reaching too high temperatures and requiring the injection of water into the interior of the cylinder.

### Admission of Scavenging Air

Controlled admission of scavenging air is secured by a device by means of which the volumetric efficiency of the air drawn into the cylinder can be maintained as high as possible and always in proportion to the quantity required for the scavenging work. In this way better combustion is secured, a higher efficiency of power obtained and the resistance offered to the air by the ordinary automatic valves suppressed.

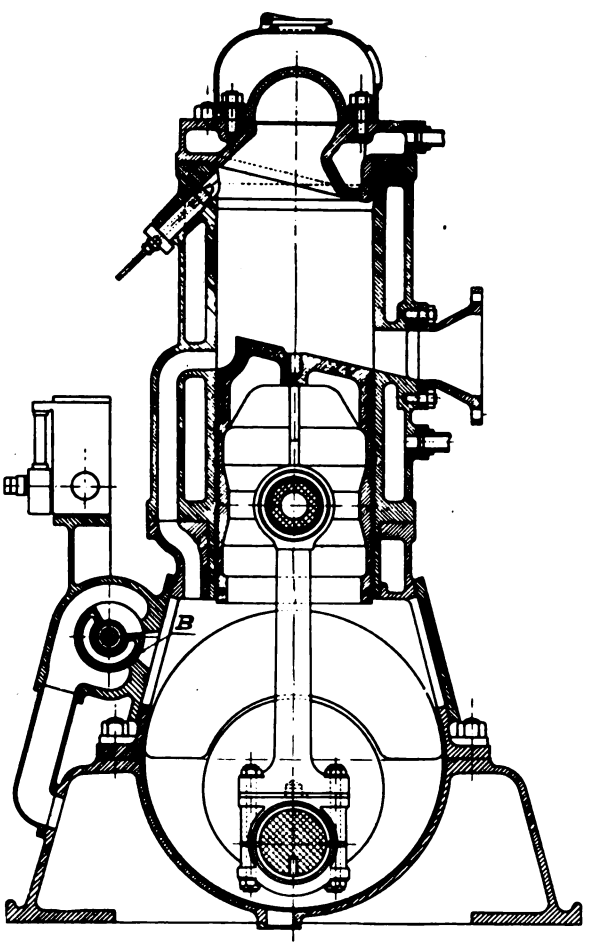


Fig. 1

With this device (see rotary cylindrical valve *B*, Fig. 1), the working conditions were observed for charges varying from 20 to 120 percent of the normal.

The engine founded on the two cycle system, with the consequent absolute absence of valves, will work with any type of mineral heavy oil, and it was therefore anticipated that the same engine would also work successfully with vegetable oil.

### Results of First Series of Experiments

The first series of experiments with an engine of 20 brake horsepower at 400 revolutions per minute was made employing ordinary heavy oil with a specific gravity of 0.9. The results were as follows:

| *R.P.M.* | *B.H.P.* | *Consumption per H.P. Hour* |
|---|---|---|
| 405 | 23 5 | 260 |
| 411 | 27.3 | 293 |

It is to be observed that the consumption of fuel is noteworthily low for a high speed engine working at an overload.

The second series of experiments has been made with Winter cotton oil having the following characteristics:

Color = yellow (straw).
Limpidity = opalescent.
Density at 15 degrees = 0.920.
Inflammability temperature = 185 degrees Centigrade.
Ignition temperature = above 250 degrees Centigrade.
Reaction = neutral.
Calorific power = 9,573.

### Results of Second Series

The experiments carried out with the cotton oil have given the following results:

| *R.P.M.* | *H.P.* | *Consumption per H.P. Hour* |
|---|---|---|
| 412 | 22.8 | 299.1 |
| 413 | 25.7 | 340.9 |

With heavy oil the discharge of the burnt gases was absolutely invisible, but with cotton oil there were slight smoky traces.

The third series of experiments was made with palm oil having the following characteristics:

Color = yellow.
Consistency = buttery.
Density at 15 degrees = 0.9.
Engler viscosity at 50 degrees = 3.5.
Inflammability temperature = 280 degrees Centigrade.
Ignition temperature = 325 degrees Centigrade.
Calorific power = 9,350.

As may be seen, the values of the viscosity and density, and the points of inflammability and ignition are all high in comparison to the heavy oils usually employed. The use, therefore, of vegetable oil as fuel does not appear to be possible with all types of engines.

### Results of Third Series

The results of the third series of experiments were as follows:

| *R.P.M.* | *H.P.* | *Consumption per H.P. Hour* |
|---|---|---|
| 423 | 21.1 | 312 |
| 395 | 24 | 328 |

The consumptions, compared with those of heavy oil, are higher but the ratio is nearly equal to that of the calorific powers.

With palm oil as fuel the discharge of burnt gases was nearly invisible.

After the experiments, the bulb was removed and only very slight traces of carbonaceous deposits were found.

The above experiments are very important owing to their essentially practical nature leading to a further extension of the use of hot bulb engines. Moreover, the characteristics of solidity, simplicity and easiness of operation of such engines have caused them to be widely adopted. There is a still wider field for their employment in the extended colonial territories, as well as in all those countries where vegetable oils abound, and where natural conditions of the ground, difficulties and lack of transports and distance from the oil wells make the supply of mineral fuel oil difficult and dear. These conditions have heretofore nullified to a large extent the economical advantages offered by the hot bulb engines.

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Eskil Berg, of the General Electric Company, Schenectady, N. Y., sailed from New York Saturday, July 23, for a two months' vacation trip abroad. Mr. Berg was a passenger on the steamship *Dottningholm*. He will tour Scandinavia and England.

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# Diesel Electric Propulsion*

By J. B. Bassett†

*Those who have made a broad study of the subject of ship propulsion recognize that the type of drive best suited for a given ship depends upon the characteristics of the ship, its trade route and the cargo to be carried. These factors are so diversified that a definite rule cannot be set. Each class of ship must be considered separately, and very often particular ships must receive individual study. Because of these uncommon factors, there must be more than one type of propulsion, at least for the present.*

THE prime requisite of propelling apparatus is reliability. Important, but secondary considerations are economy, simplicity, cost, weight and space. The ideal drive, therefore, is that which combines reliability with all of the secondary considerations. Reliability, however, must not be sacrified for any other consideration and one must not be unmindful of the fact that the lives of the crew and passengers and the safe transport of the ship and its cargo depend absolutely upon the successful performance of the propelling machinery. The machinery must operate continuously for days and weeks, and sometimes for months, without shutting down. It is recognized that no machinery has ever been built that must not be overhauled and repaired occasionally, and since this is necessary, maintenance and repair must be given careful consideration. All parts of the machinery must be designed to be accessible without unnecessary preliminary disassembling.

For the present, it is probably best to limit the capacity of Diesel electric drives to approximately 6,000 horsepower, on account of the development of high speed Diesel engines. It is difficult to predict, however, the maximum capacity which this drive will reach as the present limiting factor is the engine. The electrical machinery offers no obstacles as it has been developed to a high state of reliability and perfection over a number of years.

## Multiple Generating Units May Be Used

With the Diesel electric drive, any reasonable number of generating units may be used, independent of the number and arrangement of the propellers. It is, therefore, possible to use a number of relatively small, reliable, high speed Diesel engines driving direct connected generators. The use of small engines eliminates practically all of the disadvantages of large engines, as the bores are small, thus reducing the heat stresses in the cylinder walls and piston heads to a minimum, and cooled pistons are not necessary. A number of small engines have a direct advantage in the way of repairs, as most of the overhauling could be done at sea, if necessary.

## Most Suitable Type of Electrical Machinery

Let us now consider the type of electrical machinery which is best suited for Diesel electric propulsion. Relatively speaking, Diesel engines of capacity suitable for ship propulsion are inherently slow speed machines as compared with turbines. Their speed regulation under varying loads and their capability of speed control are limited especially when operating in parallel, and these features have a direct bearing on the type of generators. To successfully operate alternating current generators in parallel necessitates very close speed regulation of the prime movers and unless the angular displacement between two alternating current generators operating in parallel is kept within plus or minus approximately three electrical degrees (6 electrical degrees total), there will be an interchange or surging of current between the generators. As 360 electrical degrees constitute the space between like poles, it is very evident that the engine governors would have to be highly refined and always in perfect operating condition. Further, considerable flywheel effect would have to be incorporated in the engine in order to reduce the angular variation in speed to the required minimum.

To obtain an idea of the small displacement, let us consider a 50 cycle installation in which the engines operate at 300 revolutions per minute. For this frequency and speed, the generators would have 20 poles total, or 10 pairs of poles. The permissible angular variation in mechanical degrees would, therefore, be 0.6 degree.

While such operation is successfully carried out in several land installations where the prime movers operate at constant speed, it is not considered safe practice on board ship where speed of all sets would have to be varied simultaneously. It is for this reason that alternating current is not suitable for use with Diesel electric propulsion. On the other hand, direct current not only obviates all these difficulties but possesses many decided advantages in the way of control and reserve power. With alternating current, the propeller speed would have to be varied by varying the engine speed, whereas with direct current the propeller speed is varied by adjusting the generator voltage with the engines operating always at constant speed.

Although parallel operation with direct current is not impractical, it does encounter some difficulties when voltage control is used, which are not easy to overcome. For instance, as the propeller speed is most economically and conveniently controlled by varying the generator voltage, parallel operation would necessitate very closely and carefully adjusted generator field rheostats, or generators with practically identical saturation curves and close regulating engines. For small powers where little maneuvering and practically no reduced speed running are required, armature rheostatic starting and control could be used but for large powers this adds unnecessary weight and complication besides being wasteful at reduced speed operation.

## Series Operation of Generators Ideal

The series operation of generators, however, is ideal from every standpoint such as operation, control, economy, simplicity, flexibility, etc. From the engine standpoint, series operation of generators offers the best arrangement as close regulation is not required, and thus simple governors are entirely satisfactory. From the electrical system standpoint, the series system has certain decided advantages over the parallel system, particularly as it permits the most simple and convenient arrangement of the voltage control system. The operation is independent of variation in voltage between the different generators.

With the series arrangement, more power can be obtained from remaining generator units in case of failure of one or more generator units, without providing excess capacity in the motors. The reason for this is that each of the re-

*From a paper read before the Ocean Marine Engineers' Beneficial Association No. 80, New York, February, 1921.

†General Electric Company, Schenectady, N. Y.



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maining generators can be operated at normal voltage and the field of the motors weakened to increase the propeller speed to a value which will load the remaining generator units to their full capacity. With parallel operation, it would be necessary to lower the voltage of each generator a certain amount, thereby operating them at reduced capacity; or else to operate the remaining generators at full voltage and provide additional field capacity in the motors so that the speed could be lowered the required amount by increasing the motor field. Thus, in case of failure of a generator unit, parallel operation would either afford slightly less power than series operation, or would necessitate slightly larger and heavier motors.

Series connection of the generators with the motors interposed to reduce the ground voltage to a minimum has certain advantages over parallel connection of generators. For the purpose of discussion, let us assume a single screw drive consisting of six generators and a motor consisting of two separate units mounted on the same shaft. Electrically, the machines would be arranged in series as follows: Three generators, one motor unit, three generators, one motor unit. On the basis of 250 volt generators, the maximum ground voltage would be 750 volts, although from the standpoint of current, the system has all the advantages of a 1500 volt circuit. This arrangement of generators and motors is independent of the number of either, even with an uneven number of generators in a series, the motor units may be on different screws, as in the case of a twin screw drive, and still permit independent control of the port and starboard screws. However, with the same or opposite rotation of the screws, the amount of speed difference obtainable is somewhat limited, although wholly within requirements. In this case, the speed difference between the propellers is obtained by adjusting the motor fields. An even number of generators is preferable, however, with twin screw ships as it affords more flexible control.

### Speed Control Simplified

An important operating advantage of the Diesel electric drive is the simple and convenient manner in which the speed is controlled. The motors and generators being simple wound shunt machines, it is practical to control the speed of the motor by what is known as the Ward-Leonard system. With this system, the motors are separately excited at constant voltage in one direction and the generators separately excited from the same source, but at a value and direction to suit the results desired. The speed of the motors under these conditions is directly proportional to the voltage of the generators. Therefore, any speed from zero to the maximum in either direction of rotation is obtained by simply manipulating the generator field rheostat. Since only the excitation power which amounts to 1 to 1½ percent of the generator rating is handled in the rheostat, the simplicity and economy of the system are evident. The type of rheostat usually used in such cases is permanently connected across the line and the leads to the field connected to adjustable arms so that it is not even necessary to open the generator field in going from full speed ahead to full speed astern. The armature circuits are connected through knife switches and circuit breakers. The latter are provided merely to protect against abnormal overloads. When it is desired to operate one screw of a twin screw ship in the reverse direction, it is merely necessary to reverse the motor field excitation. These operations are very conveniently controlled by simple levers at the control stand in the engine room. The switches and levers are easily interlocked in order to prevent improper operation.

### Flexibility of Reserve Power

The Diesel electric system of ship propulsion possesses a flexibility of reserve power in the case of failure of prime movers which far surpasses any other type of drive. For example, assume a case in which there are three generators and one motor. Should one of the engines fail, the remaining two units could be operated at full capacity, giving two-thirds the total voltage and the motor speed increased by weakening its field to a point where the propeller would require two-thirds of full power, with a resulting ship speed of approximately 88 percent. In the case of two engines failing, the available speed of the ship would be approximately 70 percent of full speed. And to assume the remote case of all main engines failing, the ship could make steerage way on one of the auxiliary generating sets. By auxiliary generating sets is meant the sets furnishing the excitation and power for sea auxiliaries.

The multiplicity of units of the Diesel electric system affords another advantage of great importance, namely that units can be overhauled at sea without entailing any serious loss of speed.

With Diesel electric drive there would be no necessity for having any steam aboard the ship as all auxiliary apparatus can be more efficiently driven by electricity and the heating of quarters, cargo space and fuel or cargo oil, when necessary, could be done electrically.

With the Diesel electric drive it is not necessary to use starting air during maneuvering, as the engines are not stopped; all the control and movements of the propeller being done through the electrical machinery. The only time starting air is used is when the engine is started in preparation for "stand by." It is unnecessary to call attention to the importance of this advantage.

### Auxiliaries

Mainly for reasons of control, it is decidedly preferable to isolate the propelling equipment when at sea and to provide a couple of small auxiliary sets, each having sufficient capacity to furnish the sea load and excitation. As the ship's motor driven auxiliaries are usually designed for 230 volts, the auxiliary generators should be either of the 3-wire type wound for 240/120 volts so as to provide 120 volts for lighting, or a motor generator set should be installed for lighting. It is desirable, of course, to have duplicate sources of power for lighting. A second alternative for the lighting circuits would be to have separate sets for lighting only.

While in port, the main propelling sets may be used to supply the auxiliaries and for this purpose they are provided with series windings which are connected in circuit so that the machines will operate as compound wound generators when so used. When used for propelling purposes, the series winding is not in circuit and the generators, as well as the motors are operated as pure shunt machines. These sets are usually of the 250 volt class.

Where the number of main sets is relatively large, it would not be necessary to carry duplicate auxiliary sets for the sea auxiliary load, as in case of failure of the auxiliary set one of the main sets could be separated from the propeller load and used for supplying the auxiliary load without an appreciable loss in ship speed.

The flexibility of arrangement of the Diesel electric driving machinery is so great that any emergency can be easily taken care of. Of the two arrangements of Diesel drive, the Diesel electric has the following advantages:

Less weight and consequently more cargo,
Better arrangement of machinery,
Propeller speed can be selected for best performance,
Extreme flexibility of reserve power,
Simplicity and extreme flexibility of control,
Should show lower maintenance costs,
Equal or higher net return on investment,
No starting air required during maneuvering.

### Comparison of Principal Drives

As a summary, the following table of comparison of the various principal drives will be of interest. In arriving at

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the figures given, all items of machinery and supplies necessary to the main propelling machinery were considered; foundations, water, fuel, etc., were taken into account. However, it was necessary in some cases to make certain assumptions, but an effort was made to place such assumptions on the conservative side, so as not to show an exaggerated comparison. Further, certain major figures are at great variance in practice, and the table is, therefore, given as indicative of the trend of this comparison rather than actual proportions. The figures for turbine electric drive and geared turbine drive are based on the same steam conditions.

The figures are based on a 3,000 horsepower ship operating over a 4,000 mile course at a speed of 11 knots, and making a total of 14 single trips per year. The geared turbine ship is taken as unity. Owing to the present unsettled conditions, it is hardly possible to make an intelligent cost comparison.

| Drive | Fuel Consumption | Machinery Weight |
|---|---|---|
| Geared turbine | 1 | 1 |
| Turbine electric | 1.06 | 1.05 to 1.10 |
| Direct connected Diesel | 0.49 | 1.10 to 1.25 |
| Diesel electric | 0.57 | 0.75 |

## Motorship Kennecott Makes an Economical Voyage From the Pacific Coast to New York

THE largest American built motor vessel in actual service, the *Kennecott*, owned by the Alaska Steamship Company, a subsidiary of the Kennecott Copper Corporation, recently arrived in New York from the Pacific Coast with a cargo of about 3,000,000 feet of lumber and ingot copper. The vessel is of about 6,500 tons deadweight, 360 feet long, 49 feet 6 inches beam and draws 22 feet 3 inches loaded. She was built by the Todd Shipyards Corporation, at Tacoma, and is propelled by two McIntosh & Seymour, four cycle, marine oil engines, each of 1,200 indicated horsepower.

The engines of this vessel successfully burn the same heavy grade of fuel oil (of from 14 to 16 Baumé gravity) that is ordinarily burned under boilers. The daily fuel consumption of the *Kennecott* is 55 barrels, driving the ship at a sea speed of over ten knots. This is equivalent to only 10 gallons of oil required to drive the ship one nautical mile. The engine room staff consists of eight men.

An interesting engineering feature is that all the auxiliary machinery on this ship is electrically driven. The winches for handling the cargo, as well as the anchor windlass, the capstan and the steering gear, are all driven by electric motors, the current for which is furnished by two McIntosh & Seymour engines, each of 100 horsepower driving a General Electric generator.

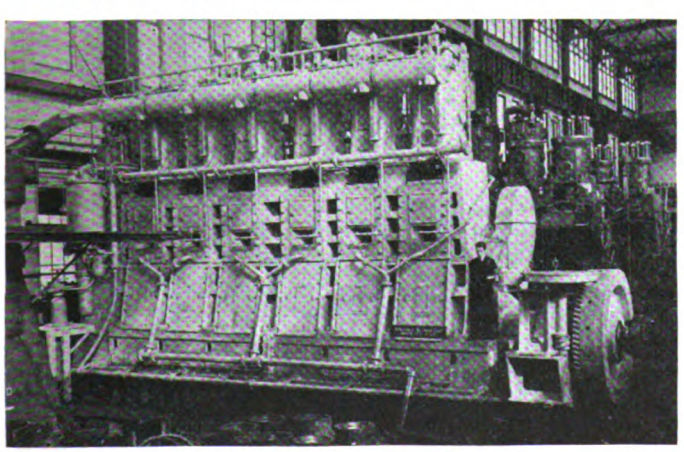


**Fig. 1.—One of the Kennecott's 1,200 Horsepower Diesel Engines**

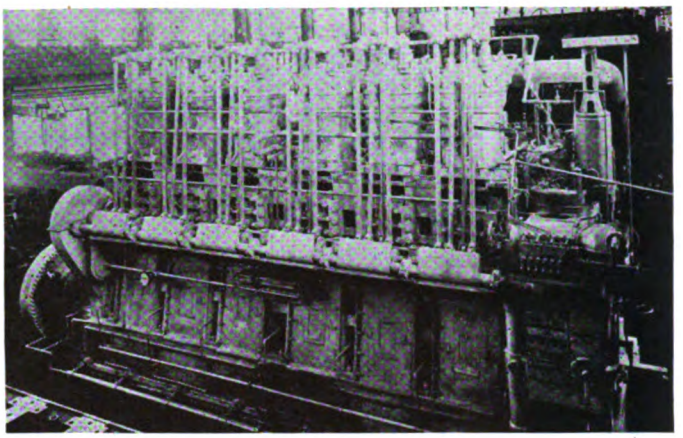
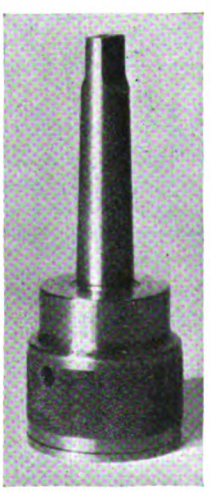


**Fig. 2.—View of the Engine, Showing Valve Gear**

A lesson to be learned from this vessel is that she requires less than half the quantity of fuel oil burned under the boilers to generate steam in a turbine or reciprocating engine driven ship, and furthermore, requires a less number in the engineer crew than is needed on a vessel of the same size, steam driven.

## Chuck for Holding Broken Drill Shanks

In reducing the small tool equipment expense in shops where twist drills are used in large quantities, a new chuck produced by the Wayne Tool Manufacturing Company, Waynesboro, Pa., for holding drills which have been broken at the shank will be found quite useful.



**Chuck Designed for Broken Drill Shanks**

The chuck is of a simplified design, consisting of but six parts: a shank, the chuck casing, two pawls, two screws, and a casing plate. Drills formerly discarded when broken may be ground to a 60 degree point at the broken end, which permits this end to automatically center itself in a corresponding 60 degree recess in the shank of the chuck. By turning the casing the pawls are brought into action and grip the drill above the grooves, thus locking it securely in the chuck. No wrenches are required to tighten or release the chuck, the hand twist of the casing alone being sufficient to cause a positive grip of the pawls on the drill end.

## Industrial Research Laboratories

RESEARCH facilities and the development activities of American industries are to be described in the forthcoming revision of *Bulletin of the National Research Council* Number 2, "Research laboratories in industrial establishments of the United States of America." Only 300 such laboratories were listed in the first edition but it is hoped that several hundred new names will appear in the revision and that a more nearly complete reference list will thus become available. The Council requests particulars of their staff, equipment and facilities from directors of research who have not already supplied it. This material should be furnished as promptly as possible to the Research Information Service, National Research Council, 1701 Massachusetts avenue, Washington, D. C. The general demand for the first edition of the Bulletin shows the wide interest in this subject and the importance of having every laboratory which devotes even a portion of its time to research properly listed.

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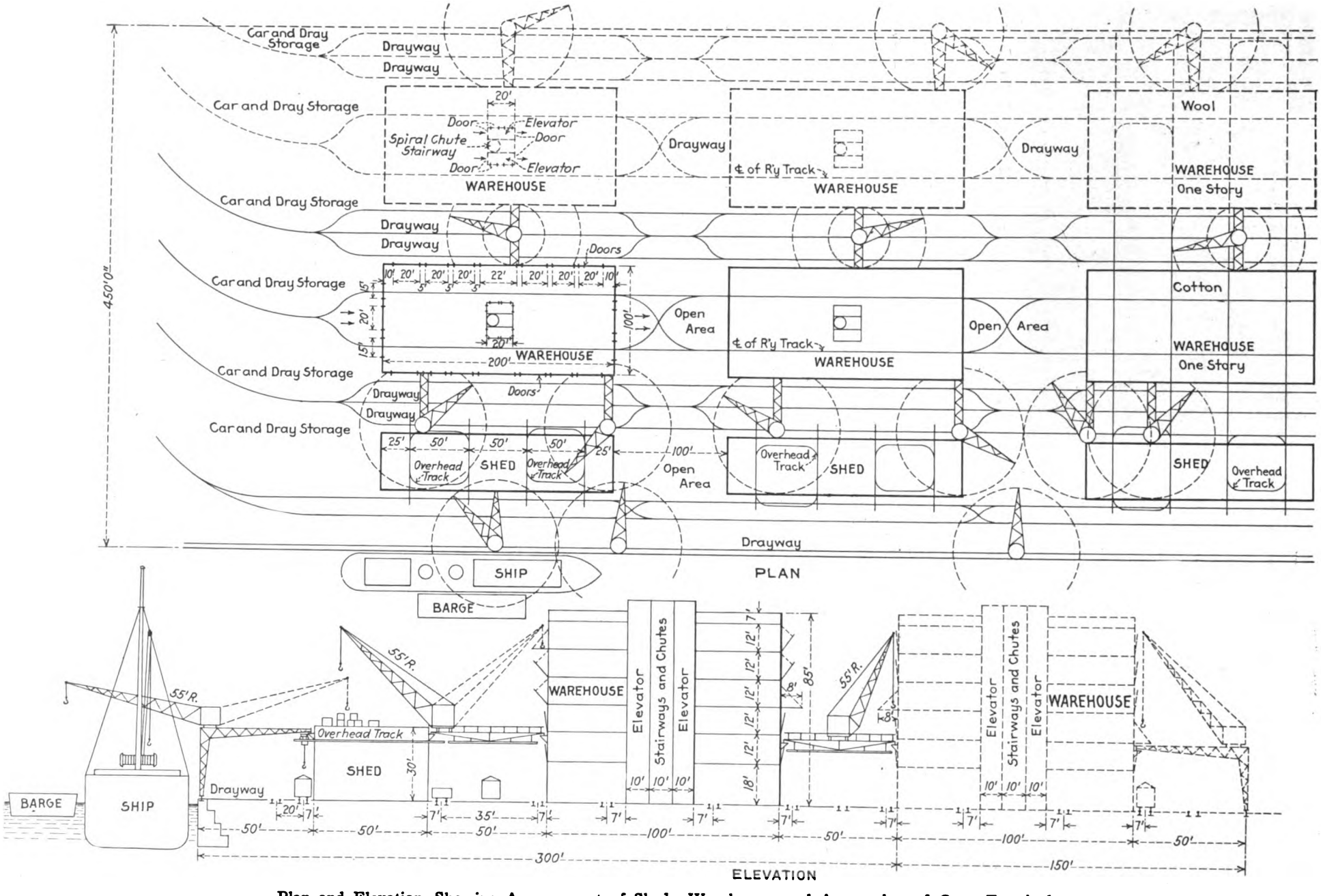


**Plan and Elevation, Showing Arrangement of Sheds, Warehouses and Approaches of Quay Terminal**

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# Quay Steamship Terminal Design

## Plan by Which Great Speed Can Be Attained in Handling Freight at Quay Terminal

By H. McL. Harding*

ONE unit area of a quay terminal may be said to comprise a waterfront length of 300 feet and a width of 150 feet or 300 feet. The 300-foot width would include warehouse and approaches.

Of this 300 feet unit length from left to right the first 50 feet as shown in the plan is for rail and dray approaches and for open storage; the next 200 feet is occupied by the transit shed with its front wall at a distance of 50 feet from the water's edge, and the remaining 50 feet is reserved for additional rail, dray approaches and storage. Fifty feet + 4 (50 feet) + 50 feet = 300 feet.

The 300 feet of width is reserved as follows:

The first 50 feet from the outer edge of the quay wall to the shed is for railway tracks and for drayways, chiefly for outbound freight; the next 50 feet is for the shed; the third 50 feet is for railway tracks and drayways, chiefly for inbound freight; then 100 feet is for the warehouse location and the next 50 feet for railway tracks and drayways. Fifty feet + 50 feet + 50 feet + 2 (50 feet) + 50 feet = 300 feet.

Another unit of 300 feet would be similar to the first unit. Originally it was the custom to make the shed and warehouses each 400 feet long, but the necessity of greater drayways and less length of detours to the waterfront rendered the changes necessary. The one unit of 300 feet is generally of ample length for river barges. Two units each of 300 feet, that is 600 feet, would be required for ocean ships.

The shed is 200 feet long and 50 feet wide and the warehouse 200 feet long and twice 50 feet, or 100 feet, wide; the distance from the warehouse to the ends of the unit is 50 feet.

This use of 50 feet as a measure will enable all dimensions to be easily remembered. All plan distances are 50 feet or multiples of 50 feet. There are two railway tracks in front of the shed and three railway tracks in front of the warehouse, that is between the shed and the warehouse, three tracks to the rear of the warehouse. There are also two railway tracks within the warehouse. Of the three tracks to the front and rear of the warehouse the center tracks are for switch connections. The various tracks as shown are connected by crossovers.

All external tracks and drayways in front of and between the buildings are spanned by traveling bridge cranes. These bridge cranes sustain foot bridges, monorails with hoists and revolving derricking jib cranes, all of which travel with the cranes. Attached to the derricking jib cranes are in addition the usual types of whip hoists. Within the warehouse in the center are two elevators with 20-foot by 10-foot platforms. Between the two elevators are spiral chutes and stairways. Motor drays are becoming larger.

The drays or tractors and trailers enter at one end of the warehouse on the ground or first floor and pass upon the platform of either of the elevators. In leaving they depart through the doors at the other ends of the elevators.

At the ground floor besides the doors at the end of the elevators, there are doors at the sides whereby freight can be unloaded from cars directly upon the elevator platforms or from the elevators through the same openings into or upon the cars. Should there be a basement of the warehouse, one of the elevators would have one of its shafts extended into the basement.

* Terminal Engineer, New York, former president, Society of Terminal Engineers.

It will be noticed that the average distance from the elevators to any part of a floor is about 60 feet. It is therefore obvious that considering the fact that warehouse freight may not be moved for several months, and also the short distances of the average freight movements, little horizontal transferring machinery will be required.

The movement, however, to and from the different floors of the warehouse, that is, the hoisting and lowering as well as the approach movements to the warehouses, should be with great speed and without congestion.

The second unit in line with the first is similar. Therefore there are 100 feet between the ends of two sheds and 100 feet between the warehouses.

On account of the fire risk it is necessary to have these buildings separated. The fire risk is far greater in the shed than in the warehouse and the two should be separated. The shed is of steel but the warehouse is of reinforced concrete.

Should there be a second line of warehouses they will be parallel to the first line. To the rear of the last line of warehouses is a traveling bridge crane, the same as the first with the outer end of the bridge crane supported on rails on a steel trestle.

### Conclusions

*First:* From six external parallel railway tracks, three on each side of the warehouse, freight can be transferred to or from any of the six floors of the warehouse, serving about 60 cars.

*Second:* From two dray areas each 50 feet in width and about 400 feet in length drays can be similarly served.

*Third:* From cars on two internal parallel railway tracks, freight may be directly delivered to or taken from elevator platforms.

*Fourth:* Drays on the ground floor can enter or leave large elevator platforms for any floor of the warehouse.

*Fifth:* For certain classes of freight spiral chutes can be advantageously utilized.

*Sixth:* The latest type of warehouse is the one space type with only one floor, that is the ground floor, and with a clear height of 50 feet. Such a warehouse is for cargoes of few consignments, as bags of coffee, rice and sugar, bales of cotton and wool, boxes of lemons and oranges, boxes of tea, cases of dry goods and barrels of liquids. There are also the combined warehouses—part being of multi floors and the rest of one floor. The cost of the one story warehouse equal in capacity to the five story is about one-fifth; the operating expense is about one-third, and the time for transferring and handling about one-fourth. The one story type may be said to be derived from the high studded terminal shed.

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# Measuring the Salinity of Boiler Water

A METHOD of measuring the salinity of boiler water and incidentally of surface condenser leakage by means of the variations of resistance offered to the flow of an electric current through water of varying degrees of salt concentration has been developed by the Leeds & Northrup Company, Philadelphia, Pa. The method, briefly stated, consists of providing for a continuous flow of the condensates and boiler waters around suitable electrodes



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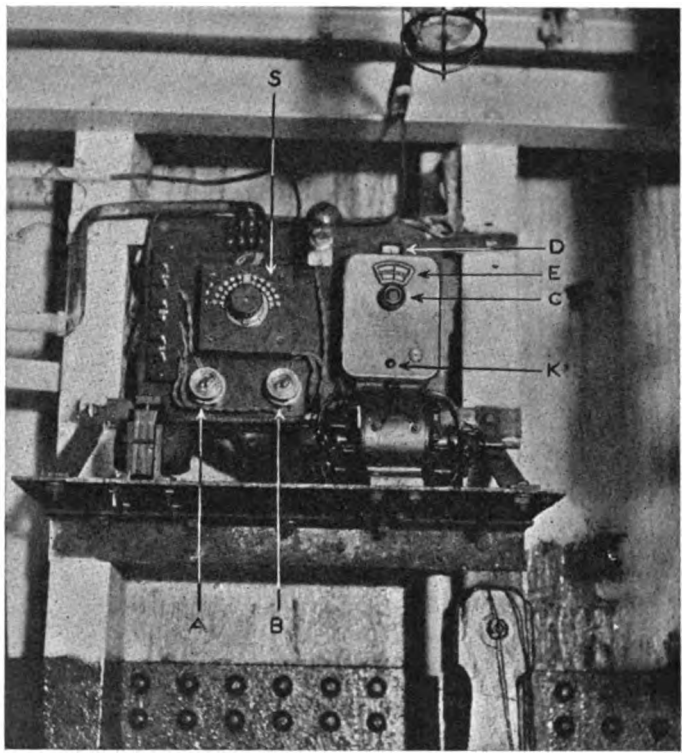


Fig. 1.—Measuring Apparatus as Installed in Engine Room of Cargo Vessel

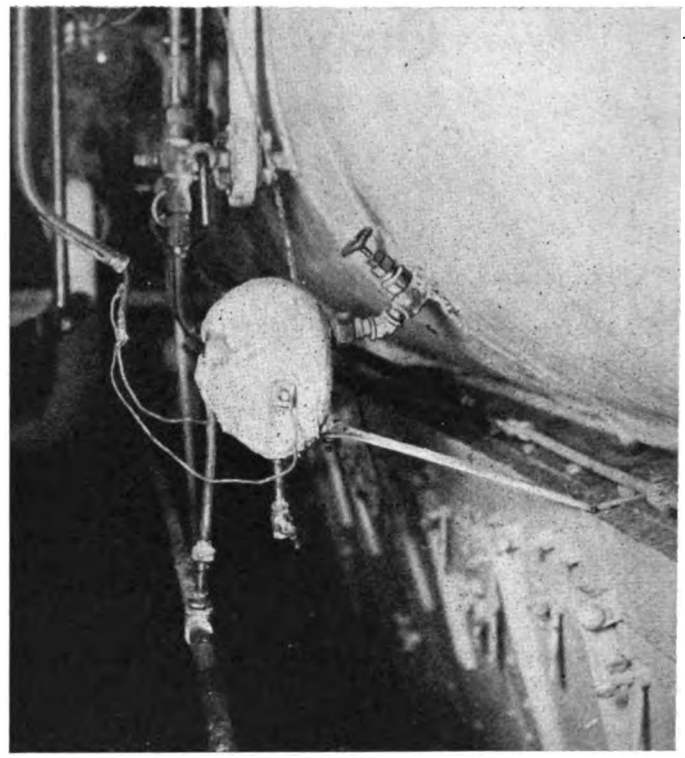

Fig. 2.—Boiler Water Cell Installed on Babcock & Wilcox Marine Boiler

arranged in pairs. The resistance offered to the flow of electric current between each set of electrodes is then measured with a Wheatstone bridge. A selector switch is provided for connecting the measuring apparatus to any one of the pairs of electrodes in the various condensates and boiler waters.

Fig. 1 shows the measuring apparatus as installed in the engine room of a cargo vessel. When in operation, switches

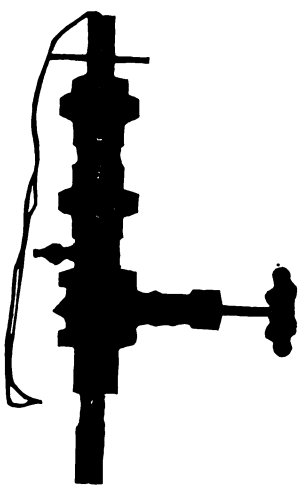

Fig. 3.—Cell for Measuring Salinity of Condensate

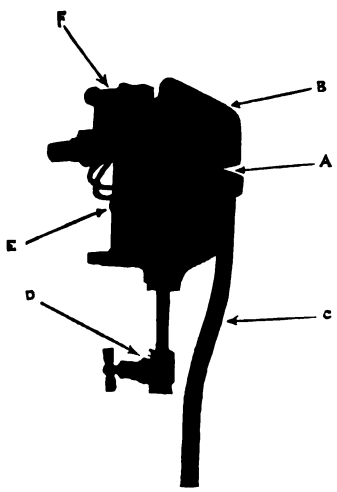


Fig. 4.—Cell for Insertion in Condensate Pipe Line

*A* and *B* are closed and the selector switch *S* turned to the position corresponding to the boiler in which the salinity is to be determined. The circuit is then closed and knob *C* adjusted until the galvanometer pointer *D* comes to rest at zero. Then the salinity may be read directly from the dial *E* in grains of chlorine per gallon. By adjustment of the selector switch the salinity in any other boiler may be determined. Fig. 2 shows a photograph of the boiler water cell installed on the Babcock & Wilcox marine boiler.

Fig. 3 shows the installation of the cell for measuring the salinity of the condensate. Two electrodes are mounted in a perforated case at the end of a brass tube. The lead wires are brought out at the other end through a rubber bushing The tube is then inserted vertically inside the outer tube to a depth sufficient to place the electrodes beneath the level of the water in the filter box.

Fig. 4 shows a smaller cell equipped for insertion in a condensate pipe line. The cell tube is mounted in the form of a gate valve, ground union and stuffing box in such a manner that the cell may be withdrawn and inspected without leakage of the condensate or interruption of service from the turbines.

## Reciprocating and Turbine Pump Governors

NEW designs of constant pressure and variable pressure "Ideal" marine pump governors have been made by the engineering staff of the Atlas Valve Company, Newark, N. J. In former designs of this governor, a gooseneck containing an oil trap was used. In both the new types this gooseneck oil trap has been eliminated, the trap being cast into the body of the governor itself, thus reducing the number of parts and eliminating the danger of leakage. The method of feeding oil to the oil bath has been much simplified. In the case of the constant pressure type governor, one stuffing box on the top has been removed.

In general the governor consists of two moving parts, a steam valve which slides backward and forward within a valve body of the double balanced valve type, and a control piston which moves backward and forward in a bath of oil within the control cylinder. This oil bath serves to lubricate the operating piston and also to prevent the liquid being pumped from entering the control cylinder. It also eliminates the possibility of the piston sticking due to corrosion or sediment. The variable pressure type governor is equipped with an emergency control lever which provides a means for manually operating the governor so that it can be held wide open or shut off tight regardless of the pump pressure.

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# Questions and Answers for Marine Engineers

**Inquiries of General Interest Regarding Marine Engineering and Shipbuilding Will Be Answered in This Department**

**Conducted by James L. Bates**

*This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.*

## Wind Resistance of Vessel's Topside and Superstructure Surfaces

Q. (1126).—Please advise as to the effect of great topside and superstructure areas upon the performance of large oceangoing vessels.

A. (1126).—This effect is manifested in several ways, each being more or less apparent as the causes to which it is attributable are present in greater or less degree in a given case. If it be assumed that the vessel has sufficient stability in all conditions, the question of the effect of the vertical distribution of the weight involved may be dismissed at once.

It then becomes necessary to consider the effect of the wind, induced or not by the vessel's speed, upon the ship. This may be manifested in the effect upon steering when under way, in the position assumed when riding to a mooring, in the effect upon the vessel's position relative to the vertical when at sea, in a tendency to drift to leeward under the action of a beam wind and in decreased speed when steaming into head winds.

Large vessels usually operate on a fixed schedule and make straight runs between ports so that maneuvering is not important. Provided the distribution of both topside and immersed surface fore and aft is reasonably symmetrical, steering characteristics should be satisfactory. High structures and light draft forward combine to make it difficult to keep a course with a wind from either bow. In this connection, note the losses which have sometimes occurred among the Great Lakes freighters after a heavy storm. These vessels have machinery aft and, when light, trim deeply by the stern. They are then difficult to control in a heavy blow.

Such an arrangement of superstructure as referred to above results in yawing when moored by the bow. This is objectionable because of the probable loss of ground tackle and the danger resulting to both the vessel itself and to other vessels anchored near by.

In considering a vessel's behavior under the action of a beam wind, we have a condition somewhat analogous to that of the sailing ship. The drift to leeward, other things being equal, will depend upon the ratio of the area of topside to that of the immersed lateral plane. When the value of this ratio exceeds about 2.25 we may expect some difficulties in handling, due to the small hold of the ship upon the water and the large hold of the wind on the ship. If, in addition to the above, the vessel in hand has been given a small value of metacentric height in order to secure easy motion in a seaway, we may expect her to assume and maintain uncomfortably large angles of heel for such periods of time as the wind may continue to act.

The retarding effect of head wind upon a high speed vessel with lofty upper works may be very pronounced. Experiments carried out upon the model of the *Mauretania* indicate that with a head wind equal to the maximum ahead speed of the vessel, about 25 knots (the velocity of the wind relative to that of the ship thus being 50 knots), an increase of 12 percent over the resistance of smooth water at maximum speed might be anticipated.

The following table shows some interesting values of rudder area ratios and ratios of areas of topside to areas of immersed planes for several large vessels:

| | Length B. P., Feet | Draft, Feet | Freeboard For'd, Feet | Freeboard Aft, Feet | Ratio: Topside area to area of central immersed plane | Ratio: Area of central immersed plane to rudder area |
|---|---|---|---|---|---|---|
| *Leviathan* | 907.5 | 38 | 52 | 37 | 2.0 | 90 |
| *Aquitania* | 865 | 36 | 48 | 38 | 1.95 | 75 |
| *Olympic* | 850 | 34.5 | 50 | 42 | 1.88 | 50 |
| Collier, loaded | 520 | 28.0 | 29 | 24 | .86 | 65 |
| Collier, light | 520 | 16.0 | 45 | 31 | 2.26 | 114 |

The above figures are not taken from the detailed plans but are believed to be sufficiently close for the purpose in hand. Deck houses and stacks have been included in obtaining the projected area of the above water portion. Masts, boats, etc., have been omitted.

The collier, when light, not only has a high topside ratio but the freeboard forward is relatively very great. In service some difficulty has been experienced in handling her. This has necessitated special ballast arrangements and the fitting of the present relatively large rudder.

## Speed of Ship and Revolutions of Propeller

Q. (1129).—I would appreciate knowing the rule or formula for figuring the miles per hour made by an ocean steamer by using the following data from the engineer's log:

| | | | R. P. M. |
|---|---|---|---|
| 4.00 P. M. | 86770 | | |
| 5.00 P. M. | 92750 | 5980 | 99.6 |

The officer of the watch would read the patent log at 5.00 P.M. and get his miles per hour as, say 10.8. If he wanted to check the distance run by using the revolutions per minute or the revolutions per hour from the engine room counter, how would he go about it from the above data?

If the chief engineer told him that the "slip of the propeller" was 15 percent for that particular ship, in what manner would it enter the calculation?

A. (1129).—There is no formula by means of which the speed of a vessel may be accurately ascertained, having given only the revolutions of the screw. In his book, "Practical Marine Engineering," Seventh Edition, pages 593 to 602, Admiral Dyson gives a brief discussion of the principles involved in the problem of propulsion. A careful study of these pages will be of value.

In order to find the speed of a ship, the following data are required:

The pitch of the propeller, expressed in feet—p.

The revolutions of the propeller per minute—R.

The slip ratio or slip, expressed as a percentage—s.

The procedure is then as follows:

(a) Multiply the pitch by the revolutions.

(b) Subtract the slip percent from 1.00.

(c) Multiply together the results from (a) and (b).

(d) Divide the result in (c) by 101.3.

If $V$ represents the speed of the ship in knots, we may express the foregoing as follows:

$$V = \frac{pR\,(1.00 - s)}{101.3}$$



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It will be noted that the above method depends for the accuracy of its results upon an exact knowledge of the pitch of the propeller and the slip (the revolutions being taken from the counter as stipulated).

As made and installed propellers are subject to variations in pitch in a given blade and in the different blades of the same propeller. In actual service, the ship herself will vary from time to time as to displacement, trim, condition of bottom. Further, the hub of the propeller and the after body of the vessel itself may be so designed as to cause abnormal eddy losses. The propellers may also be so located with reference to the hull as to work inefficiently. It will accordingly be apparent that neither the pitch of the propeller nor its slip is susceptible of accurate determination from the design data and that even with the greatest care, their measurement from the actual vessel can be closely accurate for only a given set of conditions.

The most satisfactory method of relating revolutions and speed of ship for convenient reference is by means of curves of speed and revolutions. The data from which these are plotted are obtained from standardization trials, made over a carefully measured course, under favorable conditions of weather and bottom and at known displacements. Such curves, of course, take into consideration pitch and slip and, if carefully prepared, are substantially accurate for the conditions obtaining at the time of the trials.

## Characteristics of Curve of Transverse Metacenters

Q. (1130).—Is it possible for a curve of transverse metacenters to drop as the lower drafts are approached? If so, what is the cause and is a form which gives a curve having such a characteristic a desirable one?

A. (1130).—Such a curve is easily possible, though it is seldom met in large steam vessels of the present day.

The cause is to be found in the relationship which the height of metacenter bears to the form and displacement of the vessel. The position of the metacenter in any floating vessel is determined by the value of the *B. M.* (that is the distance between the vertical center of buoyancy and the metacenter) and the vertical height of the center of buoyancy. This relationship may be expressed thus:

$$M = V.\,C.\,B. + B.\,M.$$

In which *M* is the height of the metacenter from a fixed reference line, as the bottom of keel or the load water plane. *V. C. B.* is the height of the center of buoyancy relative to the reference line. *B. M.* has been defined above.

$$\text{Now } V.\,C.\,B. = \frac{\text{moment of volumetric displacement about reference line}}{\text{volume of displacement}}$$

$$\text{and } B.\,M. = \frac{\text{moment of inertia of water plane}}{\text{volume of displacement}}$$

The transverse immersed sections of the modern steam vessel approach rectangles throughout the length of the vessel's middle body which generally accounts for the greater portion of her displacement. These sections in some modern destroyers, in certain tugs and in many cruising yachts propelled by sail approach more nearly the triangle. If we conceive two vessels, one having a constant rectangular cross section from end to end and the other having a constant triangular cross section from end to end, a study of the transverse metacentric curve of each will aid in bringing out the differences and the reasons therefor (see Figs. 1, 2 and 3).

In Figs. 1 and 2 the waterlines are numbered 1, 2, 3, 4, 5. In Fig. 3 the ordinates indicate the number of units above the base while the abscissas correspond to the waterlines.

Note that the curves of *V. C. B.* are similar in shape and that for Fig. 1 is the higher. The curves of metacenters are entirely dissimilar, that for Fig. 2 having a low point between waterlines 3 and 4, rising gradually from this point to the upper waterlines but increasing in height rapidly toward the lower waterlines. For Fig. 1 the curve of metacenters is a straight line. The differences between the two curves are largely due to differences in the values of *B. M.* (the value of *B. M.* at any point being the vertical distance between the curve of metacenters and that of the center of buoyancy).

In general, then, it may be said that vessels with flat floors have curves of transverse metacenters which rise rapidly at the lighter drafts because the volumes of displacement decrease much more rapidly than the inertia of water plane.

Vessels with great rise of floor have curves of transverse metacenters that drop rapidly at the lighter drafts because the volumes of displacement decrease more slowly than the inertia of water plane.

The form of cross section appropriate to a given type of vessel is generally fixed by considerations of cargo capacity, resistance, behavior in a seaway, etc., and the beam is fixed at a figure such that a proper value of metacentric height will result. It may be said, accordingly, that the form of metacenter curve is a minor consideration in the choice of shape of cross section.

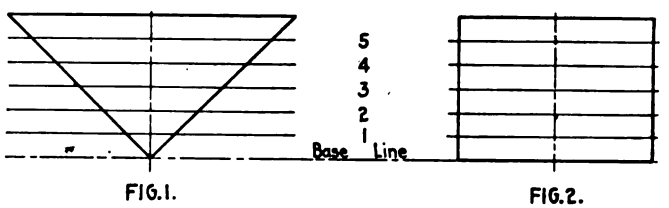


FIG. 1. FIG. 2.

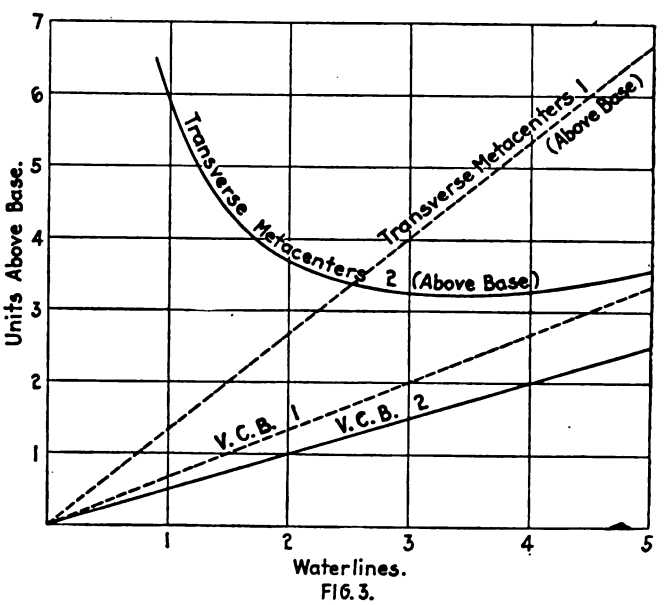


FIG. 3.

SIR JOHN HARVARD BILES is shortly retiring from his position as third occupant of the John Elder Chair of Naval Architecture and Marine Engineering at the Glasgow University, which position he has held since 1891. Professor Biles is a well known architect and has been for a long time identified with the Clydebank Shipbuilding Works, where he did original work in designing, notably the Atlantic liners, the S. S. *Paris* and the S. S. *New York*, the Russian destroyer *El Destructor* and the Spanish cruiser *Reina Rienta*. Professor Biles acts as consulting naval architect to the India office, is a past master of the Worshipful Company of Shipwrights and has been president of a number of professional and scientific societies. He has also published many works on naval architecture and marine engineering.

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## PERSONAL MENTION

A. J. FREY, a practical ship operator of twenty years' experience, has been appointed one of the three vice presidents of the Emergency Fleet Corporation who will be on the board directing the Shipping Board fleet. For sixteen years previous to 1918 he was with the Pacific Mail Steamship Company for the last eight years of which term he was assistant general manager. In May, 1918, he joined the forces of the United States Shipping Board Emergency Fleet Corporation, at San Francisco, and thereafter succeeded district manager Pillsbury, in charge of the Ship Construction Division of the Southern Pacific District. This position he held until July, 1920, when he entered the employ of the Los Angeles Steamship Company as general manager of that concern, operating passenger vessels between San Francisco and Los Angeles, a position which he resigned in order to come with the Shipping Board. Mr. Frey is 43 years of age, and is regarded by practical shipping men as an exceedingly competent executive, thoroughly familiar with ship construction and operations. While with the Pacific Mail Steamship Company Mr. Frey managed the operation of the largest fleet of steamships plying between the Pacific Coast and Oriental ports. His record with the Shipping Board has been unexcelled.

A. J. Frey

WILLIAM J. LOVE of Furness, Withy & Company, Ltd., has been appointed one of the three vice presidents of the Emergency Fleet Corporation who will be on the board directing the Shipping Board fleet. Mr. Love was born in Baltimore in 1873. He is the son of Colonel William H. Love, who is an authority on the history of Maryland and early American shipping. He was educated at St. Martin's Academy and subsequently prepared for the Naval Academy, but decided to enter the employ of Christopher Furness, who ran lines of steamers from Baltimore and Newport News to the United Kingdom. After two years' experience he entered the employ of the Atlantic Transport Company, Baltimore, and remained with this company until 1917, passing through the various departments, becoming manager of the American flag steamers of the International Mercantile Marine Company. Later he resigned to become the assistant manager in the United States for Furness, Withy & Company, Ltd., one of the largest shipping firms of Great Britain. During the war Mr. Love was the Director of Trades and Allocations under the Shipping Control Committee, and for a time acted as advisor to the Chief of Embarkation, under General Goethals. Following the armistice, Mr. Love returned to New York, re-entering the employ of his former firm as assistant manager in the United States. Mr. Love's experience has been exceedingly comprehensive, covering every aspect of the entire shipping world. He is especially familiar with competitive trade conditions throughout the world, and likewise has a large acquaintanceship with the merchants and exporters throughout the United States. His expert knowledge and acquaintanceship will be invaluable to him in the performance of the duties he has undertaken in connection with the operation of the fleet.

Wm. J. Love

J. BARSTON SMULL, of J. H. Winchester & Company, has been appointed one of the three vice presidents of the Emergency Fleet Corporation who will be on the board directing the Shipping Board fleet. Mr. Smull was born in the City of New York in 1874. His parents were Baltimorians. He was educated in the Harvard School, New York, and afterwards at Columbia College. He later entered his father's shipping business in 1894, and in 1907 he joined the firm of J. H. Winchester & Company, steamship agents and ship brokers, which firm was incorporated in 1913, when he became vice president of that corporation. The firm of J. H. Winchester & Company was established back in 1856 and is now the largest ship brokerage company in America. Mr. Smull has been closely identified with the work of the New York Produce Exchange and has been on the Board of Management the last six years, and for the last two years has been vice president of the New York Produce Exchange. He is also chairman of the Committee on Harbors and Shipping of the Chamber of Commerce in the State of New York and serves on the executive committee of that organization. During the war Mr. Smull was associated with the Shipping Board as a member of the Chartering Committee which functioned at New York. This committee had to pass on all the charters for all steamers—whether American or foreign flag—which sailed from or to an American port. During the war period that committee passed on upwards of 20,000 charter parties. Mr. Smull has had a wide experience in all branches of shipping and is thoroughly familiar with all questions in connection therewith, as well as with questions of trade routes, etc. He is recognized by all shipping interests as a foremost expert in ship operation, including trans-oceanic and coastwise.

J. B. Smull

ISAAC HARTER has been appointed general superintendent of the Babcock & Wilcox Company, New York, to succeed the late James P. Sneddon. Mr. Harter was born in Mansfield, Ohio, in 1880, and was educated in St. Paul's School, Concord, N. H., and the University of Pennsylvania. Immediately upon graduation in 1901 from the latter institution, he entered the employ of the Aultman & Taylor Machinery Company, a corporation of which his father had previously been president. He began at the bottom in the boiler department as a gang boss on inventories, and was transferred later to the cost department, where he became familiar with the details of each branch of the business. He was elected a director of the company while in this department, and a little later was appointed acting superintendent of the boiler department. In September, 1905, the company sold its boiler

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business to the Stirling Company, and Mr. Harter joined the staff of E. R. Stettinius, the business head of the latter company, which was absorbed by the Babcock & Wilcox Company in 1907. When L. I. Summers resigned the position of superintendent of the Stirling works at Barberton, Mr. Harter succeeded him, and in 1911 became superintendent of the Bayonne works. He served in this capacity until about a year ago, when he became assistant to the president, at New York, where his office will remain as general superintendent.

JUDGE WALTER D. MEALS, former associate justice of the Appellate Court of Ohio, has been appointed chairman of the United States Shipping Board Claims Commission, which is to settle all unliquidated claims, amounting to $211,000,000, which the new Shipping Board has inherited. The associate members of the commission are Homer Ferguson, president of the Newport News Shipbuilding & Dry Dock Company; F. W. Wood, former president of the Maryland Steel Company; Captain Richard M. Watt, Construction Corps, United States Navy; and Arthur W. Teele, of the accountant firm of Patterson, Teele & Dennis. The secretary of the commission will be O. P. M. Brown. The commission will probably not begin active functioning until September 1, as the new Shipping Board will require that length of time to get its cases ready. In the meantime, the commission will send notices and forms to all claimants so as to expedite the findings of the commission, once it is in session.

## LETTERS TO THE EDITOR

### Superheated Steam on Steamships

In connection with the article by Dr. Peabody in the July issue of *Marine Engineering*, I would like to draw attention to a few points in connection with the form in which data are frequently presented to show comparative performances of superheated and saturated steam installations. The data given by Dr. Peabody on page 541 show clearly the fuel saving effected by using superheat on two tow boats, but the article gives insufficient information for the use of a designer who is trying to gather data for use in proportioning new installations.

The thing that is almost always lacking in the information published about performances with superheated steam is the boiler data.

There are two main divisions of the steam plant which can behave more or less independently to either raise or lower the over-all plant efficiency, namely, the boiler and the main engine or turbine. To compare the saving due to superheat for two ships or for the same ship with and without superheat, without giving the relative boiler and engine efficiency in each case, does not benefit the designer very much.

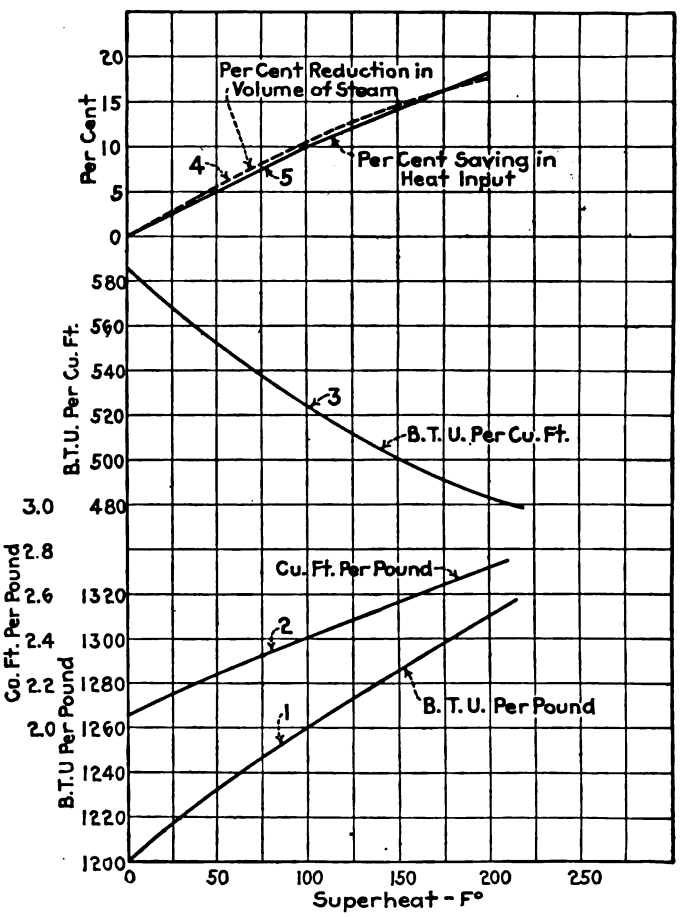
It is a characteristic of boilers that the efficiency is increased if the normal evaporation per square foot is reduced. In cases where a ship is converted from saturated to superheated steam, due to the lower engine water rate, the steam flow will be reduced and with the same boilers the required evaporation is reduced so the boiler efficiency will be increased. Therefore, in such a case, the saving due to superheat is due to higher boiler efficiency as well as higher engine efficiency.

Where useful data are to be published regarding fuel saving with superheat, it would be an advantage to the reader (since the boiler efficiency and engine water rate are probably not known), if the type of boiler and total heating surface were given.

In connection with the increased efficiency of the reciprocating engine due to the use of superheat, we may naturally expect considerable variation for different designs, but the different text books and technical magazines seem to average up about the same in giving one percent gain for every ten degrees of superheat from 0 degree up to 100 degrees and one percent for every twelve degrees from 100 degrees to 200 degrees.

It is generally considered necessary in order for an engine to develop the same mean effective pressure with superheated as with saturated steam, to increase the high pressure cutoff. This view is not at all consistent with the generally supposed economy gain due to superheat as is shown by the attached curve sheet.

Curves 1 and 2 are plotted from the values in Marks and Davis' tables for steam at 225 pounds per square inch absolute. Curve 3 is obtained by dividing 1 by 2. Curve 4 represents the percent reduction in ordinates of curve 3 based on




**Properties of Superheated Steam**

B.T.U. per cubic foot for saturated steam. Curve 5 is the increase in efficiency based on one percent per 10 degrees up to 100 degrees superheat and one percent per 12 degrees from 100 to 200 degrees superheat.

The practical coincidence of curves 4 and 5 shows that if the actual saving in steam due to superheating is as great as curve 5 indicates then an engine will give the same power for the same high pressure cutoff regardless of superheat. On the other hand, when experience shows that the volume of steam supplied to an engine has to be substantially increased for the same power using superheat then the increase in efficiency is not as great as curve 5 shows.

For any other boiler pressure a similar set of curves can be deduced and the conclusion to be derived will be the same as we have shown for the case of 225 pounds per square inch absolute.

It seems to the writer that there is a very broad field for valuable investigation in the matter of superheating. We need much more reliable data than we now have for the ratings and efficiencies of marine boilers and engines using superheat.

Newark, N. J. JAMES L. HAYNES.

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# Shipbuilding and General Marine News

**Contracts for New Ships—Shipyard Improvements —Engineering Projects—Improved Appliances**

## Marine Societies Combine to Hold Big Exposition in New York During Third Week of November

### First Annual Exhibit Will Be Held in Central Mercantile Building—"American Marine Week" Promises to Be Epoch-Making Occasion—List of Committee Members

At a meeting of the Executive Committee of the Marine Equipment Association of America, held in the office of the president, Col. Edward A. Simmons, Woolworth Building, New York City, on July 21, it was decided to hold the first annual exhibit at the Central Mercantile Building, New York City, during the week beginning November 14, next.

The Central Mercantile Building, more familiarly known as the Greenhut Building, is located on the east side of Sixth Avenue, between 18th and 19th Streets. For some years it was occupied by a retail dry goods store and during the war was taken over by the War Department and used as a hospital for sick and wounded soldiers returned from overseas. Each floor of the building contains more than 80,000 square feet of space with a floor load of 190 pounds per square foot. The first two floors have been laid out by the Manufacturers' Exhibition Company, Inc., for permanent exhibits of machinery and mechanical appliances much like the one that has existed in the Bourse Building, Philadelphia, for several years. The marine show will be held on the third floor; and all exhibits will be installed under the direction of the Exhibits Committee of the association, of which W. M. Wampler, of the Coen Company, is chairman. Applications for space as well as for membership in the association should be addressed to the secretary, K. L. Ames, Jr., American Steel Foundries, McCormick Building, Chicago, Ill.

The by-laws of the association provide that only members may exhibit. The annual dues are $25 a year; and each exhibiting member will be charged a given price per square foot for such space as he may contract. The cost for this year has not yet been determined.

It is the plan of the association to lay out the exhibit spaces in given standard units of uniform design, which may be easily put up, taken down and stored, and to buy and own all of the material for use in future years.

The action of the Marine Equipment Association in deciding to exhibit during the week in which the Society of Naval Architects and Marine Engineers will hold its annual convention and the appointment by the Council of that society of a committee consisting of Captain C. A. McAllister, chairman, J. Howland Gardner, W. H. Todd, H. H. Raymond and F. L. DuBosque to act with a like committee of the Marine Equipment Association in laying out a joint program for a big "American Marine Week," will mean much to the shipbuilding industry of this country directly, and will also stimulate public interest in the American merchant marine. Also, the American Society of Marine Draftsmen has changed the date of its annual meeting to November 14 and it is believed that other organizations in the marine field will decide to meet during that week.

The members of the executive committee are: New England District: E. B. Williams, manager marine department, B. F. Sturtevant Company, Boston, Mass., and F. L. Andrews, vice-president, Hyde Windlass Company, Bath, Me. New York and New Jersey District: M. L. Katzenstein, manager marine department, Worthington Pump & Machinery Corporation, New York; W. M. McFarland, manager marine department, Babcock & Wilcox Company, New York; H. C. Davis, treasurer, Row & Davis Engineers, Inc., New York, and Frank Hatch, vice-president, Shepard Electric Crane & Hoist Company, Montour Falls, New York. Pennsylvania, Maryland, Delaware, District of Columbia, Virginia and West Virginia District: G. W. Selby, secretary-treasurer, Marine Decking & Supply Company, Philadelphia, Pa.; J. C. McQuiston, director of publicity, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.; William Stayton, president, Baltimore Steamship Company, Baltimore, Md., and W. P. Smith, superintendent of sales, Wm. Cramp & Sons Ship & Engine Building Company, Philadelphia. South Atlantic and Gulf States District: Paul Jahncke, vice-president, Jahncke Dry Docks & Shipbuilding Company, New Orleans, La. Great Lakes District: F. C. Bradbury, manager marine department, Crane Company, Chicago; J. D. Sarles, manager marine department, Pyle-National Company, Chicago; H. L. Hibbard, manager marine department, Cutler-Hammer Manufacturing Company, Milwaukee, Wis.; and J. H. Redhead, assistant manager of sales, National Malleable Castings Company, Cleveland, Ohio. Pacific Coast District: W. M. Wampler of the Coen Company, San Francisco, and H. F. Alexander, president of the Pacific Steamship Company, Seattle.

The Finance Committee consists of W. M. McFarland, Babcock & Wilcox Company, chairman, and J. R. Tiebout, Jr., of W. & J. Tiebout.

## SUCCESSFUL TRIP

### Steamship "George Washington" Satisfactory on Trials

On Saturday, July 16, the *George Washington* sailed for Boston for the double purpose of dry docking—New York not having a dock large enough—and trying out her machinery and equipment. She carried on this trip a total of 650 persons divided as follows: crew, 414; mechanics and watchmen, 193; shipping men and representatives of the Shipping Board, United States Mail Steamship Company and manufacturers of marine equipment, 43.

On the way up the time was devoted to checking and adjusting the compasses, rudder indicators, annunciators and all the equipment used in working the ship. Although full speed trials were not attempted on this leg on account of the condition of the vessel's bottom, her engines were well tested for various combinations of maneuvering power such as going ahead with one engine while reversing with the other.

Upon her arrival at Boston on Monday morning she immediately entered the 1,200 foot Commonwealth Dry Dock where a train of pontoons was quickly arranged along her sides so that the workmen could start scraping her underbody as the water was being pumped out of the dock. She was cleaned and painted before three o'clock Tuesday, when she was again floated and ready to proceed on her return trip.

After passing Boston Light on her way back the engines were turned up to full speed, turning over at 82 revolutions per minute, which corresponds to a speed of 18½ knots. The ship was kept at practically full speed for the entire return trip, showing that the machinery is in excellent working order. Very little vibration is noticeable at full speed, but around 11 or 12 knots there is a point where there is considerable vibration.

The stewards' department was also under trial, having to care for 650 men, and we are glad to say that the service and food compared favorably with those of the old established lines.

The *George Washington* will be in excellent shape for her initial trip on August 3, as the reconditioning work is now practically complete. She will take 250 members of the American Legion to France on this voyage, where they will be the guests of the French Government. They will be royally entertained for seventeen days.



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# "Archer" and "Independence," Electrically Driven, On Sea Trials

Sea trials for two electrically driven ships were run off by the new trial board of the United States Shipping Board outside of Sandy Hook, N. J., when the newly converted ships *Archer* and *Independence* were given their official tests on July 21 and 14, respectively. Commander V. V. Woodward is chairman of the recently named trial board, the other members being H. B. Taylor, chief turbine engineer; A. K. Nichols, local Shipping Board manager at Philadelphia, and A. Conti, manager of the technical department at New York. In the absence of other members of the board on various assignments, the two electric drive trials were conducted by Chief Turbine Engineer Taylor. Both trials were announced as being highly successful.

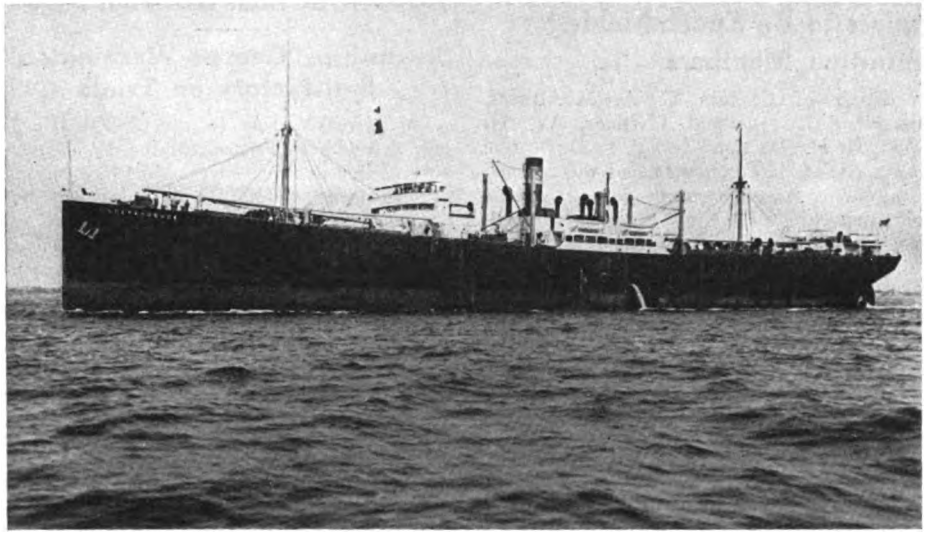
Both ships are of 11,868 deadweight tons, 440 feet in length, and were built by the Bethlehem Shipbuilding Corporation on the west coast. The General Electric Company supplied the electrical equipments, the installations being by the Tebo Yacht Basin Company, Brooklyn, N. Y., one of the Todd Shipyards Corporation plants.

The results of the trials of the *Archer*, which was commanded by Captain F. A. Branen, were coincident with those of the *Independence*, Captain Crozier.

"Everything proved entirely satisfactory," Mr. Taylor said upon the return of the *Archer*. "The electric drive mechanisms and all the auxiliaries functioned perfectly and the trial was one of the most successful we have ever run. The propeller developed between 100 and 102 revolutions per minute, giving the ship a speed of about 11 knots. She carried and maintained easily between 200 and 210 degrees of superheat."

In addition to a large number of shipping men, naval architects and engineers attending both trials, representatives were on board from the General Electric Company, the Superheater Company, White Fuel Oil Engineering Corporation, Wilson & Monahan, Diamond Power Specialty Company, Chadburn Ship Telegraph Company of America, American Navigator Log Corporation, the American Bureau of Shipping, and the Todd Shipyards Corporation.

The *Archer* and *Independence* are sister ships of the *Eclipse* and *Invincible*, which have already made successful voyages as electrically propelled cargo carriers. In each case the electric equipment has been installed under the supervision of the Shipping Board.



**Independence Completing Trials**

## NEW FERRIES

### New York to Spend Close to Half Million on Boat Lines

With a total of $995,000 expected to be made available in the immediate future—$695,000 for the Grand Street Ferry Line and $300,000 for the Dyckman Street Terminal—the Department of Plant and Structures of the City of New York will probably spend close to half a million dollars for boats, terminals and equipment, according to official information obtained by MARINE ENGINEERING. In addition, the department carried on the work of blowing up the sunken ferryboat *Queens*, which had been an obstruction in the College Point slip for some time, and Commissioner Whalen is said to be seriously considering the building of the Dyckman Street terminal with department labor and engineers. "We have met with such success in overcoming unexpected obstacles," Commissioner Whalen said, "that we can probably save about $75,000 by building the Dyckman Street terminal ourselves."

The contract for the construction of a pontoon, to cost about $5,000, is expected to be given out for bids during the course of the Dyckman Street work, and the $300,000 appropriation includes outside bids for such equipment as gears, etc.

In connection with the Grand Street Ferry Line, $695,000 has been voted, of which sum $444,000 is for the construction or the purchase of boats, $45,970 for the purpose of contracting for pontoons, gears and similar equipment; $125,030 for labor,

## CHANGED MODEL

### Satisfactory Results Favor Trial of West Lewark on Pacific Coast

Attended by Meyer Lissner, one of the recently appointed members of the United States Shipping Board, William Chisholm and F. C. Brandt, respectively manager and district comptroller of the Pacific District, Emergency Fleet Corporation of the United States Shipping Board; also by officials of the shipbuilding company, and a number of friends, the sea trials of the *West Lewark*, run the middle of June, proved eminently satisfactory.

This 11,500-ton flush deck freighter is the first to be completed of the five of her class being built and engined by the Los Angeles Shipbuilding & Dry Dock Company under contracts with the United States Shipping Board. Four hundred and fifty-five feet and nine inches over all, the *West Lewark* type is engined by the same 3,500 I.H.P. marine engine designed and built in the shops of this company for twenty-seven out of a total of thirty-five cargo carriers, which their contracts with the Shipping Board call for. The first thirty of these ships, twenty-two of which have the same type of engine as the above, were of 8,800 tons. Their over all length was 423 feet 5 inches. Considerable interest was, therefore, shown by all officials in the speed to be developed by the changed model with increased length in a ship designed to carry nearly 3,000 additional tons and with exceptionally efficient cargo storage and handling arrangements.

The *West Lewark* has been chartered by the Williams, Diamond & Company, Pacific Coast shippers. Capt. W. C. Ansell has been appointed master for the new ship by the operating company, and has arrived here to take charge of the ship and prepare for immediate sailing to San Francisco, Columbia River and Puget Sound points to load general cargo for the maiden voyage to London, Liverpool and Continental ports.

Notwithstanding the number of Shipping Board vessels reported as idle, the exceptional cargo storage and cargo handling facilities provided by the *West Lewark* made her particularly attractive to shippers for the Pacific-European trade.

## Tanker Launched

The "Eurana," a single screw 63,000, 42-gallon barrel oil steamer, built at the plant of the New York Shipbuilding Corporation, Camden, N. J., was launched at 12:25 P. M., Saturday, July 16, 1921. It was christened by Miss Mary Eurana Ward, daughter of Dr. and Mrs. M. R. Ward, of Wayne, Pa., and niece of Mrs. Charles M. Schwab, of New York.

The over all dimensions of the ship are 435 ft. 8 in. in length, beam 56 ft. 3 in., and depth 25 ft. 10 in. She is equipped with 3 single end, Scotch, return tubular boilers. The main engine is of the vertical inverted triple expansion type, surface condensing, with three cranks at angles of 120 degrees. It is designed to develop sufficient power to propel the ship at least eleven (11) knots per hour with ship loaded to a mean draft of 25 ft. 6 in.

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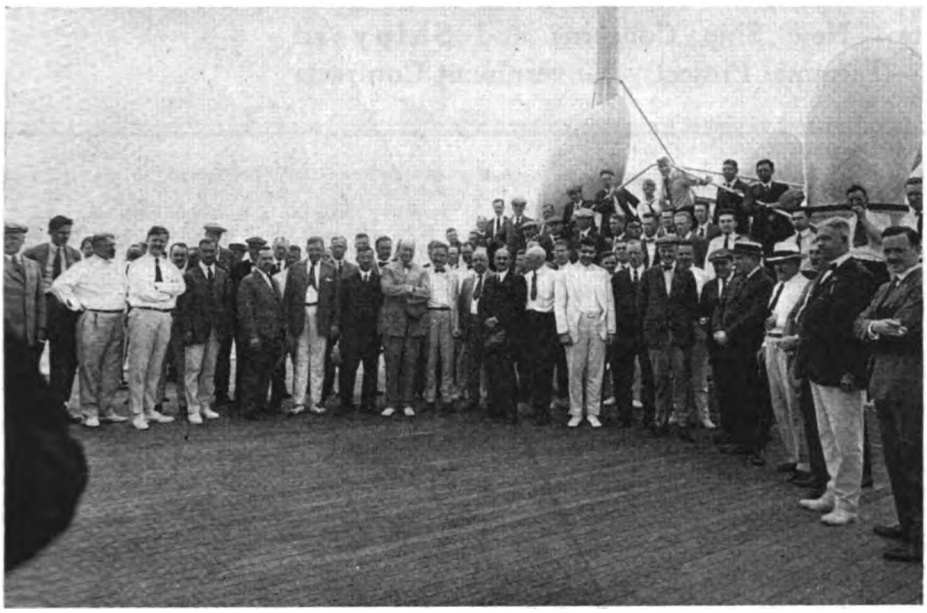
# Steamship "American Legion" on Maiden Voyage After Trial Trip



**Visiting Party on Board**

On Saturday, July 16, the flag of the United States Shipping Board on the steamer *American Legion* was replaced by that of the Munson Steamship Line, with nearly every cabin occupied by guests of Mr. Munson. The steamer left the yards of its builders, the New York Shipbuilding Corporation, Camden, N. J., at 5:30 p. m., eastern standard time, and arrived at Pier 3, Hoboken, N. J., the following day at 4.30 p. m., daylight saving time.

The steamship *American Legion,* named in honor of our victorious soldiers, is one of the nine craft of 21,250 tons displacement being built at the plant of the New York Shipbuilding Corporation, Camden, N. J., for the United States Shipping Board. Since its launching, the *American Legion* has been allocated for operation to the Munson Line and will be run in the fast passenger service between New York and South American ports. Owing to the particular service to be performed by this vessel, it was necessary to make certain structural changes to meet the requirements for a maximum of air, light and space necessary for comfort in tropical travel. The vessel measures 535 feet over all and has a beam of 72 feet. It is equipped with twin turbines of 12,500 horsepower which will give it a speed of 17½ knots and has accommodations for 280 first class passengers, 194 third class passengers in addition to a crew of 198 officers and men.

In the party, besides Mr. and Mrs. Frank C. Munson were A. M. Neeland, president of the New York Shipbuilding Company and Mrs. Neeland; Shipping Board Commissioners Edward C. Plummer and Meyer Lissner; R. D. Gatewood, director of construction and repair; Harry C. Gahn, member of Congress from Ohio; Col. Thomas W. Miller, alien property custodian, and a number of members of the American Legion, including Col. Henry D. Lindsley, past national commander; William F. Deegan, vice-commander of the Department of New York; James M. Blackwell, chairman of the executive committee of the First District; George F. Kelly, adjutant, Department of New York; Col. E. A. Simmons, chairman of the American Legion Committee for the Reception and Disposition of Bodies from Overseas and also Commander of Kings County Post No. 500; Donald C. Strachan, chairman of the executive committee, Kings County; J. Noble Braden, vice-chairman, executive committee, Queens County; Col. Frank E. Evans, Lt. Col. Robert M. Watkins and Thomas W. Ward, Jr.

The *American Legion* sailed on its maiden voyage to South America on July 23. It is expected that her regular running time to the first port at which she will stop, Rio de Janeiro, will be approximately 10 days, which is some two days better than the record now held by the *Aeolus,* also of the Munson Line.

## Sideways Launching a Success

The first sideways launching of a large ship in Baltimore occurred June 25, when the oil-burning tanker *San Leopoldo,* built by the Globe Shipbuilding & Dry Docks Company for the Eagle Oil Transportation Company, of London, went into the water at the Globe plant, Fairfield.

The *San Leopoldo* is the first of two tank steamers contracted for by the Eagle Oil Transport Company of London. The launching of this vessel for British interests is particularly significant in connection with the contract recently secured by the New York Shipbuilding Corporation for the construction of a large vessel for the Japanese government, as it shows that the American shipbuilder is a factor to be reckoned with in the world market for the construction of vessels.

## ASKS $300,000,000

### Chairman Lasker Makes Requests for Shipping Board

A comprehensive statement of the results of operation by the United States Shipping Board during the past year, which he said revealed a most deplorable system of accounting and gross incompetence and inefficiency in operation as a result, was made public by Chairman A. D. Lasker on July 18 as a preliminary to a conference with the chairmen of the Appropriations Committees of the House and the Senate on July 20 to ask for an appropriation of approximately $300,000,000 for the coming year. Of this he estimated that about $150,000,000 would be required to meet operating losses and $150,000,000 to pay claims. Before outlining the situation in a statement to the Washington newspaper correspondents Mr. Lasker had gone over the financial statement with the President, who, he said, was "shocked and dismayed" at the portrayal of conditions, and who had directed that the state of affairs be made public. The situation was presented as being so bad that the administration does not purpose to inherit it without acquainting Congress and the public with it in order that they may understand under what conditions the new board is beginning its work and in order that they may be fully informed of the results for the future.

According to the statement, the net expenditures of the Shipping Board for the year ended June 30, 1921, were $380,000,000, of which $220,000,000 represented a clear loss from operation, and it was announced that a reversal of policy had been decided upon so that cash realized from the sale of capital assets may no longer be expended for operating purposes, but shall be turned into the Treasury so that the direct loss from operation shall be known. This will make it possible to ascertain what it costs to operate a merchant marine and whether it will be necessary for the government to adopt some form of paternalistic aid.

While referring frequently in his statement to the deplorable bookkeeping and incompetency in the past management of the board and the "deception" of Congress and the people, Mr. Lasker said he was not intending to place the blame upon anyone, but to emphasize the conditions which face the new management. He said that even the $300,000,000 estimate of the requirements for this year was merely the most intelligent "wild guess" that could be made. The statement was made in the presence of Alonzo Tweedale, the general controller, and two of his assistants, and Mr. Lasker said that neither they nor Admiral Benson were responsible for a condition which they had inherited from the war emergency and had not had time to straighten out.

"The books are in deplorable condition," Mr. Lasker began; "in any commercial institution they wouldn't be called books at all. They were started in the stress of war and continued in the stress of incompetency until Mr. Tweedale and the others are now trying to straighten them out. Any of our great corporations would have been in receivers' hands long ago as a result of the way the books alone have been kept.

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# Marine Construction News of the Month

## Ship Contracts — New Ship Concerns and Shipyard Improvements—Terminal Projects—Government Contracts

## SHIPS AND SHIPBUILDING

**Oil Barge, Charleston, S. C.**—It is reported that the Charleston Navy Yard has been authorized to construct an oil barge of 1,000 tons carrying capacity.

**To Build Yacht, Morris Heights, N. Y.**—The Consolidated Shipbuilding Corporation has received a contract to design and build a fast day cruiser for a prominent New York City yachtsman.

**Standard Co. Awards, Shooters Island, N. Y.**—On bids totaling approximately $2,500, the Standard Shipbuilding Corporation was awarded contracts for repairing the steamers Major Normoyle and Cantigny of the Army Transport Service.

**Contract Award, Brooklyn, N. Y.**—The James Shewan & Sons Company was awarded the contract for repairs to the steamer Buffalo Bridge, bids for which were opened at 45 Broadway, New York, on July 8. The price was $1,540.

**To Repair Steamer, Seattle, Wash.**—A contract for repairs and alterations to the steamship Keystone State was let to the Pacific Coast Engineering Works at a bid of $11,500.

**Repairing Sound Steamer, Hoboken, N. J.**—The W. & A. Fletcher Company has been awarded the contract for repairing the side-wheel Sound steamer C. W. Morse, of the Hudson Navigation Company. Repairing the broken starboard shaft is included in the work which it is understood will total close to $10,000.

**Contract Award, Hoboken, N. J.**—The Shipping Board steamer Sarcoxie, was awarded to the Tietjen & Lang Dry Dock Company for repairs, on a bid of $1,079.

**Tanker Repair Contract, Baltimore, Md.**—The Standard Oil Company on Wednesday, July 13, awarded the contract to dock and repair the tanker Muskogee to the Globe Shipbuilding & Dry Dock Company at its bid of $5,100.

**Ferryboat, Ont., Canada.**—It is reported that a company is being organized to build an automobile ferryboat to operate between Sarnia, Ont., and Port Huron, to handle the large motor tourist traffic across the St. Mary's River.

**To Alter and Repair Wenatchee, Seattle, Wash.**—Extensive alterations and repairs on the Shipping Board steamer Wenatchee will be recommended as a result of the trial run on Puget Sound recently in which the vessel showed many faults.

**To Convert Steamers, Portland, Ore.**—According to G. F. Matthews, shipbuilder, negotiations are under way for the financing by Eastern capital of the conversion of four more Ferris type Shipping Board wood hulls into sailing schooners at Portland, Oregon. Mr. Matthews has just completed the conversion of a Ferris type hull into the schooner Undaunted. Mr. F. C. Knapp, president of the Peninsula Lumber Company, is on the east coast conducting the negotiations.

**Repair Contract, Shooters Island, N. Y.**—The Standard Shipbuilding Corporation was awarded the contract for dry docking, painting and overhauling the Shipping Board steamer Cokato at a price of $4,041.

**To Repair Destroyer, San Diego, Cal.**—Six weeks' repairs will be necessary to place the United States destroyer Dent in cruising condition, according to an official announcement received by the commandant of the 11th naval district. The Dent was struck by a torpedo recently during smoke screen exercises off San Clemente Island.

**Ship Repairs at Baltimore, Md.**—The steamer Inland, in port from Portland, was docked at the lower plant of the Baltimore Dry Docks & Shipping Company for overhaul. The Baltimore Dry Docks & Shipbuilding Company was awarded the contract by the Shipping Board for repairing the steamer Elmsport at a bid of $1,113.

**To Repair Lightships, Baltimore, Md.**—A contract to dock and repair lightship No. 101, Cape Charles Station, has been awarded to the Baltimore Dry Docks & Shipbuilding Company. The Norfolk Shipbuilding & Dry Dock Company was awarded the contract for docking and painting light vessel No. 2.

**Shipping Board Contracts, Brooklyn, N. Y.**—The Robins Dry Dock & Repair Company with a bid of $4,181 has been awarded the contract for repairs to the Shipping Board steamer Old North State; the W. & A. Fletcher Company, Hoboken, has been awarded the repairs for the steamer Oronoke at a price of $3,530; the National Dry Docks & Repair Company has been awarded repairs on the steamer West Point at $2,544. Bids for these contracts were opened by the Shipping Board on July 6.

**Will Launch Combination Vessel, Sparrows Point, Md.**—Early in July the Sparrows Point plant of the Bethlehem Shipbuilding Corporation launched the largest vessel ever built at a Baltimore shipyard, and which was the first of four combination oil and ore carriers now on the stocks. This vessel is being built for the International Petroleum Company. All of the vessels are 550 feet long, 72 feet beam and 32 feet molded depth, to have a deadweight capacity of 20,500 tons. This vessel, as well as the other three, are being built on the Bethlehem Frear patent combination for carrying oil, ore, coal and merchandise. They will be driven by reciprocating engines with steam supplied by three Scotch boilers.

**Hulls as Pile Rafts, Seattle, Wash.**—Declaring that the hulls of many wooden ships now lying in Lake Union can earn millions if properly handled, Captain E. D. Barrett, of 2846 Alki Avenue, Seattle, is completing arrangements by which three hulls which he already owns will be used as molds or carriers to transport part of the immense piling order which New York will need to carry out her newest $15,000,000 harbor improvement plan. The hulls will necessarily have to be towed. It will cost approximately $16,000 to dock and fit the Ferris and Geary hulls for the trip and the outfitting and repowering of the steamer Roosevelt for the towing job involves more capital, which Captain Barrett is at present negotiating for. In towing these hulls to the East Coast with their cargo of piles, valued at $4,500,000, it is believed that Captain Barrett can deliver the full lot of 80,000 piles at a saving of $2,000,000. After unloading, the hulls are to be pumped out and towed back to the Sound in light ballast for another cargo.

**Merchant Yard Activities.**—The activity of the Merchant Shipbuilding Corporation in the general engineering field is evidenced by the consummation of two contracts running into large sums of money. One contract calls for the construction of two structural steel radio towers at Annapolis and for the remodeling of four existing towers. The towers contemplated are 600 feet in height.

The other contract provides for the construction of sixteen movable steel platforms for the construction firm of Snare & Triest, of New York. The latter firm is at present building some docks at Stapleton, S. I., and it is in connection with this work that the platforms are needed.

The Merchant Shipbuilding Corporation has filed bids for some 55 different kinds of construction work. These two are the successful bids that were announced thus far.

**Light Vessels, Math, Maine.**—Official announcement is made of the awarding of the contract for five light vessels by the Department of Commerce, Bureau of Lighthouses, Washington, D. C., to the Bath Iron Works, Ltd., in the amount of $920,000, this being the lowest bid received. The award is based upon the proposal of this company to build the first three vessels for $200,000 and additional vessels up to and including five ships for $160,000. The lightships are to be 132 feet 4 inches in length, 30 feet beam molded, of 775 tons, and will be equipped with one compound 16 inch by 31 inch engine, developing 400 indicated horsepower with a boiler working pressure of 120 pounds.

**Steamer Repairs, Brooklyn, N. Y.**—Tenders were opened at 3 P. M., on July 13 at the office of Scott & Surtees, Consulting Engineers, 80 Broad Street, New York, for repairs to the steamship Fort Morgan, of the Di Georgio Line, which was recently damaged in collision with an unknown schooner at sea. The contract was awarded to the Morse Dry Dock & Repair Company on a bid of $8,650 and ten days.

**Recondition Tanker, Brooklyn, N. Y.**—The contract for overhauling and cleaning the tank ship Delmira, bids for which were opened on Monday, July 11, was awarded to the Robins Dry Dock & Repair Company on a total bid of $10,505. The Delmira recently arrived at New York in tow from the south. The large quantity of oil floating in her hull is to be removed, the specifications being in two sections.

**Repair Tankers, Newport News, Va.**—The Newport News Shipbuilding Company was awarded contracts for docking and repairing the Danzig oil tankers Zoppot and Baltic which have been operated by the Standard Oil Company in the Mexican oil trade. The company was the lowest bidder at a price of $6,250 for the Baltic and $7,412 on the Zoppot. Other bids for the Baltic were: Baltimore Dry Docks & Shipbuilding Company, $6,996; Globe Shipbuilding Company, $9,116; Bethlehem Shipbuilding Corporation, $13,908; and for the Zoppot, Baltimore Dry Docks & Shipbuilding, $7,975; Globe, $10,636; Bethlehem, $16,920.

**Repair Contracts, Baltimore, Md.**—Contract to dock and repair to steamer Cushnoc was awarded by the Shipping Board to the Globe Shipbuilding & Dry Dock Company, Baltimore, Md., on a bid of $5,280. The steamer West Lasraway was awarded to the Bethlehem Shipbuilding Corporation, Sparrows Point, Md., on a bid of $4,160. Five other dock and repair contracts were also awarded this week by the Shipping Board, as follows: Steamer Sutherland to the Baltimore Dry Docks & Shipbuilding Company, at $8,277; steamer Capulin, to the Bethlehem Shipbuilding Corporation, $2,470; the Belvedere, to the Baltimore Dry Docks at $1,244; repairs to the Des Moines Bridge to the Spedden Shipbuilding Company, at $167 and the National Bridge to the same company at $531.

**Activities at Fletcher Yard, Hoboken, N. J.**—The Fletcher Company has been awarded the repair work incidental to scheduled voyages on five ships of the United Fruit Company's fleet. The vessels are the Santa Marta, Zapaca, Tivivies, Sixaola and Carrillo, of about 5,000 gross tons each. These ships ply between New York and South American ports.

The Fletcher Company has also been awarded the contract for repairs and a special No. 3 American Bureau survey on the steamship Transportation of the Coastwise Transportation Company at an estimated cost of $10,000. Other awards to the same company include the Shipping Board steamer Panhandle State for the opening of all main and auxiliary machinery for inspection and survey in addition to local voyage repairs, at a figure of $2,300; the Shipping Board steamer Gaffney for dry docking and voyage repairs, about $2,000; and the revenue cutter Seneca for dry docking, general overhauling and reconditioning. It was stated that although the Fletcher Company's dry dock will be moved from the north side of pier 3 to the south side of the same pier, the dry dock will continue in operation without interruption, the removal being for the purpose of providing sufficient depth in the slip so that the dock will lift ships of greater draft than any other dock of its size in the port.

**Repair Ship.**—Bids were opened on June 28 for repairs to the United American Line steamer Suffolk, and the Morse Dry Dock & Repair Company was announced as having been awarded the contract at a price of $20,500. Other bidders were: Standard Shipbuilding Corporation, $18,500; James Shewan & Son, $21,000; Newport News Shipbuilding & D. D. Co., $21,400; Atlantic Basin Iron Works, $23,000; New York Harbor Dry Dock Co., $23,667; National Shipbuilding Company, $24,184; W. & A. Fletcher Company, $26,800; Crane's Shipyard, $34,000; Merchant Shipbuilding Corporation, $53,080.



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# CONSTRUCTION FOR NAVY

Vessels under construction for the United States Navy and their degree of completion as reported June 30, 1921, by the Bureau of Construction and Repair, Washington, D. C., are as follows:

| Type | Number and Name | Contractor | Per Cent. of Completion July 1 Total |
|---|---|---|---|
| | | BATTLESHIPS (BB) | |
| 44 | California | Mare Island Navy Yard | 98.0 |
| 45 | Colorado | New York S. B. Corpn. | 75.4 |
| 46 | Maryland | Newport News S. B. & D. D. Co. | 99.5 |
| 47 | Washington | New York S. B. Corpn. | 67.3 |
| 48 | West Virginia | Newport News S. B. & D. D. Co. | 57. |
| 49 | South Dakota | New York Navy Yard | 32.2 |
| 50 | Indiana | New York Navy Yard | 29.8 |
| 51 | Montana | Mare Island Navy Yard | 26.1 |
| 52 | North Carolina | Norfolk Navy Yard | 35.8 |
| 53 | Iowa | Newport News S. B. & D. D. Co. | 26.3 |
| 54 | Massachusetts | Beth. S. B. Corpn. (Fore River) | 8.6 |
| | | BATTLE CRUISERS (CC) | |
| 1 | Lexington | Beth. S. B. Corpn. (Fore River) | 21.1 |
| 2 | Constellation | Newport News S. B. & D. D. Co. | 11.5 |
| 3 | Saratoga | New York S. B. Corpn. | 24.2 |
| *4 | Ranger | Newport News S. B. & D. D. Co. | 2.0 |
| 5 | Constitution | Philadelphia Navy Yard | 9.2 |
| 6 | United States | Philadelphia Navy Yard | 9.2 |
| | | SCOUT CRUISERS (LIGHT CRUISERS CL) | |
| 4 | Omaha | Todd D. D. & Const. Corpn. | 93.0 |
| 5 | Milwaukee | Todd D. D. & Const. Corpn. | 90.5 |
| 6 | Cincinnati | Todd D. D. & Const. Corpn. | 84.4 |
| 7 | Raleigh | Beth. S. B. Corpn. (Fore River) | 59.7 |
| 8 | Detroit | Beth. S. B. Corpn. (Fore River) | 59.8 |
| 9 | Richmond | Wm. Cramp & Sons Co. | 67. |
| 10 | Concord | Wm. Cramp & Sons Co. | 64. |
| 11 | Trenton | Wm. Cramp & Sons Co. | 47. |
| 12 | Marblehead | Wm. Cramp & Sons Co. | 45. |
| 13 | Memphis | Wm. Cramp & Sons Co. | 39. |
| | *Battle cruiser No. 4—Keel laid 6-23-21. | | |
| | | AUXILIARIES | |
| | Fuel Ship No. 18, Pecos (Oiler A06) | Boston Navy Yard | 97.2 |
| | Repair Ship No. 1, Medusa (AR1) | Puget Sound Navy Yard | 63.6 |
| | Dest. Tender No. 3, Dobbin (AD3) | Philadelphia Navy Yard | 64.8 |
| | Dest. Tender No. 4, Whitney (AD4) | Boston Navy Yard | 28.9 |
| | Sub. Tender No. 3, Holland (AS3) | Puget Sound Navy Yard | 20.2 |
| | Aircraft Tender, Wright (AZ1) | Tietjen & Lang | 80. |
| | | PATROL VESSELS | |
| | Gunboat No. 22, Tulsa (PG22) | Charleston Navy Yard | 69.2 |
| | Authorized but not under construction or contract. (1) Transport No. 2. | | |
| | | DESTROYERS | |
| 338 | Wasmuth | Mare Island Navy Yard | 98.1 |
| 339 | Trever | Mare Island Navy Yard | 95.0 |
| 340 | Perry | Mare Island Navy Yard | 63.3 |
| 341 | Decatur | Mare Island Navy Yard | 59.5 |
| | Destroyers authorized but not under construction or contract. (12) Nos. 348 to 359 inclusive. | | |
| | | SUBMARINES | |
| 115 | S-10 | Portsmouth, N. H., Navy Yard | 92. |
| 116 | S-11 | Portsmouth, N. H., Navy Yard | 88.4 |
| 117 | S-12 | Portsmouth, N. H., Navy Yard | 82.8 |
| 118 | S-13 | Portsmouth, N. H., Navy Yard | 77. |
| 123 | S-18 | Electric Boat Co. (Quincy) | 97. |
| 124 | S-19 | Electric Boat Co. (Quincy) | 96.5 |
| 125 | S-20 | Electric Boat Co. (Quincy) | 98.5 |
| 126 | S-21 | Electric Boat Co. (Quincy) | 94.9 |
| 127 | S-22 | Electric Boat Co. (Quincy) | 95.8 |
| 128 | S-23 | Electric Boat Co. (Quincy) | 94.0 |
| 129 | S-24 | Electric Boat Co. (Quincy) | 93. |
| 130 | S-25 | Electric Boat Co. (Quincy) | 93.5 |
| 131 | S-26 | Electric Boat Co. (Quincy) | 92.4 |
| 132 | S-27 | Electric Boat Co. (Quincy) | 91. |
| 133 | S-28 | Electric Boat Co. (Quincy) | 91.6 |
| 134 | S-29 | Electric Boat Co. (Quincy) | 90.5 |
| 136 | S-31 | Electric Boat Co. (San Fran.) | 97.5 |
| 137 | S-32 | Electric Boat Co. (San Fran.) | 95.9 |
| 138 | S-33 | Electric Boat Co. (San Fran.) | 99.2 |
| 139 | S-34 | Electric Boat Co. (San Fran.) | 95. |
| 140 | S-35 | Electric Boat Co. (San Fran.) | 91.2 |
| 141 | S-36 | Electric Boat Co. (San Fran.) | 87.2 |
| 142 | S-37 | Electric Boat Co. (San Fran.) | 84.5 |
| 143 | S-38 | Electric Boat Co. (San Fran.) | 75.2 |
| 144 | S-39 | Electric Boat Co. (San Fran.) | 72.3 |
| 145 | S-40 | Electric Boat Co. (San Fran.) | 72.6 |
| 146 | S-41 | Electric Boat Co. (San Fran.) | 75.5 |
| 153 | S-42 | Electric Boat Co. (Quincy) | 67.7 |
| 154 | S-43 | Electric Boat Co. (Quincy) | 67.9 |
| 155 | S-44 | Electric Boat Co. (Quincy) | 66.3 |
| 156 | S-45 | Electric Boat Co. (Quincy) | 67. |
| 157 | S-46 | Electric Boat Co. (Quincy) | 65.4 |
| 158 | S-47 | Electric Boat Co. (Quincy) | 64.9 |
| 159 | S-48 | Lake T. B. Co. (Bridgeport) | 93.3 |
| 160 | S-49 | Lake T. B. Co. (Bridgeport) | 86.2 |
| 161 | S-50 | Lake T. B. Co. (Bridgeport) | 85.3 |
| 162 | S-51 | Lake T. B. Co. (Bridgeport) | 78.2 |
| | | FLEET SUBMARINES | |
| 60 | T-2 (SF 2) | Electric Boat Co. (Quincy) | 98.7 |
| 163 | V-1 (SF 4) | Portsmouth, N. H., Navy Yard | 2.8 |
| 164 | V-2 (SF 5) | Portsmouth, N. H., Navy Yard | 2.8 |
| 165 | V-3 (SF 6) | Portsmouth, N. H., Navy Yard | 2.8 |
| | Note: Submarines authorized but not under construction or contract. Fleet submarines (6) Nos. 166 to 171. Neff submarine (1) No. 108. | | |

**Ferryboat, Seattle, Wash.**—It is announced that bids will soon be asked for a passenger ferry to ply between Seattle and Puget Sound Navy Yard, for which plans have already been approved. The vessel will have a large passenger and auto carrying capacity and will cost about $500,000.

**Overhauling Vessels, Seattle, Wash.**—For annual overhauling and repairs the steamships Norwood and Redwood of the Pacific American Fisheries Company's fleet are now drydocked at the Todd Shipyards, and surveys to determine the extent of the work being made. A new stern frame is being installed on the Shipping Board freighter West Jester, and it is expected the vessel will be ready for her sailing on August 1. The surveying of the big transpacific passenger liners Wenatchee and Keystone State continues at the Todd yard. As soon as this is done bids for repairing the vessels will be asked and let at once.

**Repairing Steamer, Baltimore, Md.**—The Baltimore Dry Docks & Shipbuilding Company was the lowest bidder for the contract to dock and repair the steamer Eastern Importer of the United States Shipping Board, at a bid of $2,757. The Bethlehem Shipbuilding Corporation bid $2,850, and the Globe Shipbuilding & Dry Dock Company, $2,999.

**Tanker Repairs, Hunters Point, Cal.**—The hull of the new tanker Scopas was damaged when the vessel was recently launched from the ways of the Southwestern Shipbuilding Company, and will be repaired at the No. 2 graving dock of the Bethlehem Shipbuilding Corporation. The vessel has a tonnage of 8,400.

**Repair Contract Awards, Baltimore, Md.**—To dock and repair the steamer Lake Elon, the Shipping Board awarded the work to the Baltimore Dry Docks & Shipbuilding Company on its bid of $1,687. The Globe Shipbuilding Company bid $2,257, and the Bethlehem Shipbuilding Corporation $1,868. The steamer Labette was awarded by the Shipping Board to Obrecht & Company at $370; and the Lake Felden to the Union Shipbuilding Company at $458.

**Battleship to be Launched, Camden, N. J.**—According to an announcement from the Navy Department the Washington, the third American battleship having electric propulsion, will be launched at Camden, N. J., early in September. The new Washington is a sister ship of the Maryland, which it is expected will be turned over to the Navy early in August, and the Colorado and West Virginia, now in the course of construction, all mounting 16-inch guns.

**New Cable Ship, New York.**—Plans and specifications have been sent to various shipbuilders by J. W. Millard, naval architect, of 17 State Street, New York City, for the construction of a Western Union cable ship which is to be equipped with four Diesel engines, driving electric generators and motor with a brake horsepower for the main engine estimated at 2,000. The vessel is to have twin screws. She will be 324 feet between perpendiculars, 356 feet over all length, 42 feet 6 inches molded breadth, 25 feet molded depth.

**Alterations on Liners.**—It was reported in marine circles that specifications will be forthcoming for alterations to the steamship Panhandle State to provide for accommodations for 600 steerage passengers and incidental repair work which it was thought would reach the approximate total of $100,000. It is also understood that plans are being prepared for the carrying out of betterments for the steamship America in the amount of about $60,000.

**Ferryboats, New York.**—Maurice Nicholls, of 90 West Street, New York City, is in the market for two double-ended side wheel or screw ferryboats having a speed of about nine or ten knots. A passenger carrying capacity of 1,500 is desired.

# SHIPYARDS AND DRY DOCKS

**New Dry Dock, Kearney, N. J.**—The Federal Shipbuilding Company announces the completion of its new dry dock. The dock measures 438 feet from tip to tip in length with an over-all width of 110 feet. It is of the Donnelly type made up of nine pontoons and will take a vessel of 9,000 long tons and up to 460 feet in length.

**May Purchase Plant, Harriman, Pa.**—It is reported that the Merchant Shipbuilding Corporation is negotiating with the United States Shipping Board, Washington, D. C., for the acquisition of the plant, of which the company owns the land and the Government the buildings. A new structural department was established recently and the company has started work in this new department.

**To Build Diesel Engines, San Francisco, Cal.**—The Bethlehem Shipbuilding Corporation is putting in facilities at its local plant as well as at the company's works in Alameda for the manufacture of American-Diesel marine engines on a large scale. J. J. Tynan is general manager.

**New Dry Dock to be Installed, East San Pedro, Cal.**—According to an announcement made by J. A. Talbott, vice-president and general manager of the Southwestern Shipbuilding Company, a new 12,000 ton floating dry dock will soon be installed at the plant of the company. This organization's huge plant at East San Pedro will not be dismantled upon the completion of its present contract on October 1, but will continue in the shipbuilding and ship repair field.

# PORT IMPROVEMENTS

**Wharf, Etc., New Orleans, La.**—The Dock Board will expend $275,000 on a wharf for Alabo and $57,000 on the Government barge terminal.

**Dock, Houston, Texas.**—W. C. Hogg and associates contemplate the construction of a dock and handling plant for coal and other heavy commodities.

**Building Dock, Kalama, Washington.**—Captain Jack Reid of the Reid Transportation Company has a new landing dock under construction at Kalama between the depot and the Hoven ferry dock for the use of his ferryboats.

**Harbor to Be Improved, Port Lavaca, Tex.**—The city plans to improve its harbor with an expenditure of about $125,000. Address the mayor.

**To Improve Channel, Lincoln, Ill.**—The Commissioners, Upper Salt Creek, D. D., plan to improve the channel, involving 1,000,000 cubic yards. Kelker, Gates and DeLeuw, Conway Building, Chicago, are the engineers.

**Wharf, Etc., Orange, Tex.**—The city, W. E. Lea, mayor, voted $250,000 bonds to construct additional wharf and dock facilities.

**Dock, Mobile, Ala.**—Harry Pillans, mayor, will complete the construction of the Arlington docks and contemplates the voting of bonds for this purpose in the amount of $500,000.

**Dredging, Cleveland, Ohio.**—The city plans to dredge three miles of the Cuyahoga River, involving the expenditure of about $1,000,000. R. Hoffman, City Hall, is engineer.

**Dock, Houston, Tex.**—The Humble Oil and Refining Company plans to build a 20 by 100 foot concrete pile and slab construction dock near Morgan's Point for bunkering and loading oil barges.

**Bulkhead, Baltimore, Md.**—The Public Improvement Commission in compliance with a request from the United States Engineers, will construct a temporary bulkhead to cost $4,000, across the river frontage of Mud Island space. Bancroft Hill is harbor engineer.

**Pier, Bayonne, N. J.**—The Union Sulphur Company, 17 Battery Place, New York, has awarded a contract for the construction of a pier to cost about $20,000, to Henry Steers, Inc., 17 Battery Place, New York.

**Wharf, New Orleans, La.**—The Dock Board is planning the construction of a $400,000 wharf behind which a warehouse will be built by the Mississippi Warrior Barge Line at New Orleans for the purpose of developing that port as a clearance port for flour and cotton. The proposed wharf will be approximately 600 feet long and 75 feet wide.

**Seawall, Scituate, Mass.**—J. H. Williams, 76 Faysant Street, Boston, Mass., has been awarded a contract by the Department of Public Works for building 2,300 feet of concrete seawall, 13 feet high, and involving 4,300 cubic yards of concrete.

**Pier, Bradentown, Fla.**—W. Curry, administrator of the Curry Estate will construct a pier at the foot of Sunset Drive, on the Mantee River.

**To Dredge Channel, Portland, Ore.**—The Port of Portland Commission has received from the United States Army Engineers, Washington, a permit for the proposed improvement of the North Portland harbor by the dredging of a channel 25 feet deep and 300 feet wide, and by the construction of wing-dams, according to plans.

**Dredging, Etc., Mass.**—The estate of J. R. Burke, 28 School Street, Boston, Mass., has been awarded a contract for dredging, placing rip-rap, and removing boulders in Harwichport, Harwich, Hyannisport, Falmouth, Inner Harbor, Osterville, North Falmouth, and Martha's Vineyard. The work will involve the expenditure of $67,612.

**Bulkhead, New York.**—Murray Hulbert, Commissioner of Docks, Pier A, North River, New York, has let a contract for reconstructing the sheet pile bulkhead along Shore Boulevard, Sheepshead Bay, contract No. 1715, to G. W. Rogers & Company, Inc., 29 Broadway, New York City. The job involves the expenditure of $47,370.

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**Piers, Miami, Fla.**—The city will construct additional piers at the municipal docks, and will receive bids until July 20 for part of the $400,000 project development which will double the capacity of the present docks. Charles W. Murray is engineer in charge.

**Freight Handling Equipment, Orange, Texas.**—Freight handling and conveying machinery will be installed on the new wharf and dock which the City Council plans to construct in the near future. Bonds in the amount of $250,000 have been voted for this project.

**Bulkhead, Boston, Mass.**—W. L. Miller, 171 Alford Street, Charleston, Mass., was awarded the contract for the construction of a 2,400-foot oak pile and hard pine timber bulkhead on Commonwealth Flats, at a price of $56,000.

**Deepen Channel, Tallahassee, Fla.**—The city has asked for an appropriation of at least $100,000 for the purpose of deepening the channel of the Blackwater Bay and the Blackwater River up as far as the town of Milton in Santa Rosa county. The bill has been taken up for consideration.

**Dumping Board, New York.**—Murray Hulbert, Commissioner of Docks, Pier A, North River, New York, has let a contract to the Phoenix Construction Company, 41 Park Row, for building the substructure for the proposed dumping board on East 35th Street. This work will cost about $69,797.

**Docks, Port Arthur, Ont.**—The Palentine Mining & Development Company proposes to buy 200 acres on the Stratcona property near Bare Point for $10,000, including the water rights for the construction of four ore docks with a capacity of approximately 500,000 tons, rack dock to be 100 feet wide and about 1,000 feet long. They are to be of concrete and steel on an elevation, including trestles, of 80 feet. The foundations will be of concrete and the hoppers and main sections of steel of the same type as the ore docks at Duluth and Two Harbors, Minn. A by-law is to be submitted to Port Arthur taxpayers shortly concerning this proposed construction.

**Dredging, Cloverdale, B. C.**—The municipality of Surrey has let a contract for dredging and dyking on the upper part of the Serpentine River to H. B. Sullivan & Company, 47 Albert Crescent, New Westminster, to cost $34,000.

**Hydraulic Dredge, St. Louis, Mo.**—The Mississippi River Commissioner, International Life Building, is receiving bids for furnishing a 12-inch hydraulic dredge for the Mississippi to cost about $112,000.

**Sub-structure of Pier, Philadelphia, Pa.**—George F. Sproule, director of the Department of Wharves, Docks and Ferries, 550 Bourse Building, will receive bids endorsed "Bids for the construction with appurtenant work, of the sub-structure of Girard Pier, No. 3, North Delaware River," until 12 o'clock noon (daylight saving time), Monday, August 1, 1921. Plans and specifications and blank forms upon which bids must be made can be obtained at the office of Director Sproule upon the deposit of a certified check in the sum of $25.

**Wharf, Houston, Tex.**—Mayor Holcombe has authorized the construction of Manchester wharf and has directed City Engineer to prepare plans and specifications.

**Bulkhead, Etc., Tampa, Fla.**—The city will expend about $1,000,000 for harbor improvements to include a bulkhead, etc. A. W. D. Hull is city manager.

## GOVERNMENT WORK

**Machine Shop, Fort Crockett, Tex.**—The Bureau of Yards and Docks, Navy Department, has awarded a contract to J. N. McCannon, Fort Bliss, Texas, for the construction of a one-story addition to the machine shop.

**Dump Scow, New York.**—The Phoenix Construction Company, 41 Park Row, New York, was the lowest bidder for the construction of a dump scow at the Navy Yard, New York, (1) work complete, $20,897, sixty days; (2) add $40, deduct $20; (3) add $0.05, deduct $0.25; (4) add $1,553 (5) deduct $50.

**Quay Wall Extension, San Diego, Cal.**—Specification 4484, the Bureau of Yards and Docks, Navy Department, Washington, D. C., plans to construct a quay wall extension involving the expenditure of about $106,000.

**Dredging, Etc., San Diego, Cal.**—Specification 4485, the Bureau of Yards and Docks, Navy Department, Washington, D. C., plans to dredge, fill and repair the base.

**Dock and Piers, St. Louis, Mo.**—The War Department, Washington, D. C., has leased a site on a profit-sharing basis to erect a $40,000 dock of wood construction and two concrete piers, each to cost $90,000, which will connect with Wiggins Ferry.

**Dispensary, Washington, D. C.**—Specification 4486, the Bureau of Yards and Docks, Navy Department, Washington, D. C., plans to construct a dispensary estimated to cost about $75,000.

**Steam Cranes, Puget Sound, Wash.**—Specification 4478, the Bureau of Yards and Docks, Navy Department, Washington, D. C., plans to construct two 50-ton steam cranes for the dry dock at Puget Sound, at an estimated cost of $320,000.

**Road to Dry Dock, South Boston, Mass.**—Specification 4477, the Bureau of Yards and Docks, Navy Department, Washington, D. C., plans to construct a road to the drydock.

**Machine Shop, San Diego, Cal.**—The Bureau of Yards and Docks, Navy Department, Washington, D. C., let the contract for constructing a machine shop, fire engine house, etc., at the Naval air station to the K. E. Parker Company, 519 California Street, at a figure of $121,400 and 210 days.

**Radio Towers, Sitka, Alaska.**—Specification 4445, the Bureau of Yards and Docks, Navy Department, Washington, D. C., let a contract for constructing two 300-foot steel radio towers and one 200-foot Guyed Tubular Mast at the Naval Radio Station to the Hurley-Mason Company, 4 North Main Street, Seattle, Washington, at a cost of $22,220 and 175 days.

**Contract Let for Machine Shop, Hampton Roads, Va.**—W. F. Martins, 53 Franklin St., Rochester, N. Y., was awarded the contract, Specification 4382, by the Bureau of Yards and Docks, Navy Department, Washington, D. C., for constructing the machine and carpenter shop at a price of $108,434 and 165 days.

**Electric Power Plant, Craney Island, Va.**—The United States Shipping Board, Washington, D. C., plans to construct a new electric power plant near Norfolk, Va., and to install an electrically operated pumping plant.

**Repairs to Dredge, Charleston, S. C.**—The United States Engineer Office, Munitions Building, Washington, D. C., has let a contract for repairing the dredge Barnard to the Charleston Dry Dock & Machine Company at a price of $22,599.

**Machine Shop Foundation, Pearl Harbor, T. H.**—Specification 4396, The Bureau of Yards and Docks, Navy Department, Washington, D. C., has rejected bids received on June 29 for constructing a foundation for a machine shop.

**To Sell Vessels, Washington, D. C.**—The Shipping Board will receive proposals up to August 2 at its office in Washington for three ex-German ships "as is and where is," now at New York. These are the Amphion, deadweight tonnage 8,950; the Freedom, 6,800 tons, and the Philippines, 13,312 tons.

**Dredging, Buffalo, N. Y.**—The United States Engineer Office will receive bids until 11 a. m., August 18, 1921, for dredging and rock excavating in the Black Rock Channel. Further information may be obtained upon application.

**Dredging, Philadelphia, Pa.**—The United States Engineer Office, 815 Witherspoon Building, will receive bids until August 22, 1921, for dredging a 35-foot channel in the lower part of the Delaware River. Further information may be obtained upon application.

**Jib Cranes, Brooklyn, N. Y.**—C. L. Cadle, superintendent of Public Works, Capitol, Albany, N. Y., will receive bids until August 17, 1921, for furnishing and installing two 3-ton electric semi-portal revolving jib cranes on the barge canal terminal, Gowanus Bay; Contract No. 118.

**Piers and Abutments, Dayton, Ohio.**—The Commissioners of Montgomery County will receive bids until August 20 for building piers and abutments for a three-span steel highway bridge across the Miami River on Sheperd Road, involving 5,000 cubic yards mass. concrete, and costing about $60,000. P. S. Bookwalter is county engineer.

**Chimney, Bellevue, D. C.**—Specification 4483, the Bureau of Yards and Docks, Navy Department, Washington, D. C., plans to construct a chimney at Bellevue, D. C.

**Portable Water Supply, Lakehurst, N. J.**—Specification 4424, the Bureau of Yards and Docks, Navy Department, Washington, D. C., let a contract for constructing a portable water supply at the Naval Air Station to the H. E. Crock Company, 28 Light Street, Baltimore, Md., the work to be completed in ninety days at a cost of $12,339.

**Radio Towers, Annapolis, Md.**—Specification 4400, the Bureau of Yards and Docks, Navy Department, Washington, D. C., let a contract for building steel towers at the Naval High Power Station to the McClintic Marshall Construction Company, Munsey building, Washington, D. C. This job amounts to $112,255.

## NEW INCORPORATIONS

The Algiers Dry Dock & Ship Repair Company is to be organized in Algiers, La., shortly, according to a report coming from the leading factor in the new enterprise, Edward Berhaut, proprietor of the Algiers Iron Works and the Algiers Electric Welding Company. Mr. Berhaut is said to have asserted that the new concern will represent an investment of $1,000,000 and will be financed by local capital.

The firm of Rinelli & Guardino, Inc., Wilmington, Del., has been incorporated with a capital of $500,000 to conduct a business of scaling and cleaning ships, etc.

The Munrio Steamship Corporation, Wilmington, Del., has been incorporated with a capital of $275,000 to carry on a shipping business.

The Floating Marine Stores, Inc., Brooklyn, N. Y., has been incorporated with a capital of $10,000 by R. Simon, 2231 Emmons Avenue, Sheepshead Bay, to conduct a marine and ship supply business.

The Astoria Shipping Company, Astoria, Oregon, has been incorporated with a capital of $10,000 by C. K. West, B. F. Stone, and O. B. Setters, to conduct a general shipping business.

The Automatic Clutch & Transmission Company, Wilmington, Del., has been incorporated with a capital of $1,200,000 to manufacture clutches, power controlling mechanism, etc.

The Graham Sloan Company, Inc., 15 Exchange Place, Jersey City, N. J., has been incorporated with a capital of $250,000 to carry on a business of building, construction, dredging and demolishing.

The Frontera Fruit & Steamship Company, Wilmington, Del., has been incorporated with a capital of $150,000 to own and operate boats.

The Benson Electric Company, Superior, Wis., has been incorporated with a capital of $1,000,000 by M. B. Johnson, Arthur W. Highfield and Horatio V. Gard, Superior, Wis., to do a contracting business; attorney, Corporation Trust Company of America.

The International Marine Life Savings Equipment Corporation has been incorporated with a capital of $520,000 to carry on a business of marine specialties; Kyriajos Souliotis, John E. Ellys, Far Rockaway, N. Y., and Michael Johnell, New York, are the incorporators; attorney, U. S. Corporation Company.

The Iroquois Navigation Company has been incorporated with a capital of $500,000 by Harry C. Hand, Samuel B. Howard, and Robert K. Thistle, all of New York; attorney, U. S. Corporation Company.

## FOREIGN ACTIVITIES

**Graving Dock, Sunderland, Eng.**—A new graving dock is to be constructed in the port of Sunderland by Messrs. T. W. Greenwell & Company, Ltd. The dock will be 550 feet long and 71 feet wide at the entrance, and will be able to accommodate the largest vessels built on the Wear.

**Clyde Output for May.**—In May Clyde shipbuilding companies launched nineteen vessels aggregating 22,752 gross tons, bringing the totals for the five months of the year to date up to 102 vessels and 195,429 tons gross. During the month two vessels of 186 tons were launched from Forth yards and a vessel of 500 tons from a Scottish Northeast Coast yard.

**Converted Cargo Vessel, Newcastle-on-Tyne, Eng.**—The Newcastle Engineering Company, Ltd., Tyne Dock, recently completed an interesting conversion job. The coasting vessel Cargo Shipper, owned by Cargo Carriers, Ltd., of London, which was an auxiliary schooner, 136 feet in length, was turned into a motor ship by the installation of a 152 brake horsepower Vickers-Petter oil engine, directly reversible, of the latest type. The auxiliary machinery is driven by a small Petter oil engine and is entirely self-contained.

**Dredging, Alexandria.**—The Great Pass at Alexandria is to be dredged to a depth of 45 feet in connection with the proposed scheme for the construction of new docks and berths alongside which the depth of water is to be 40 feet, and which will be able to accommodate vessels 1,000 feet long. The estimated cost of the scheme for the construction of new berths is £E.1,400,000, and it is one which is greatly welcomed by the shipping industry.

**Naval Programme, France.**—The new naval programme, passed by the French Chamber on the 10th

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of June, provides for the construction of six light cruisers, twelve destroyers, twelve torpedo boats and thirty-six submarines, and the conversion of the battleship Bearn into an aircraft carrier.

**Wharf, Acapulco, Mexico.**—The Mexican Government has approved the expenditure of 75,000 pesos (equal to about $37,500 United States currency) monthly for the construction of a wharf, work upon which is to be started shortly. Plans and specifications may be obtained from the Ministro de Communicaciones y Obras Publicas, Mexico.

**New Shipyard, Belgium.**—A shipyard is being laid down on the Ghent-Terneuzen Canal by the Societe Anonyme Anglo-Belge de Constructions Navales. A number of berths will be constructed for the building of vessels from 350 feet to 660 feet in length. The depth of water at the yard is 28 feet.

**German Shipyard Expansion.** — The Deutsche Werft, A. G., which was founded in 1918 and whose yard is at Finkenwarder, is still engaged in laying out its works. It is reported that during the past year it has amalgamated with the Hamburger Werft laid out at Tollerost in 1916 and has thereby become the largest shipbuilding establishment in the country. Ship construction work began last year in May when the keels for three 2,000 ton vessels and three 4,000 ton vessels were laid. In June the nine 750-foot building berths were sufficiently advanced for an 8,000 ton turbine steamer to be laid down. The contracts in hand on December 31, 1920, numbered 28 steamers of 133,350 tons deadweight, 10 motorships of 61,200 tons, eight barges of 8,000 tons, and two floating docks of 6,500 tons, in all 209,250 tons, providing employment to June, 1922. At the present time there is renewed inquiry for motorships, tankers, and floating docks. The gross profits for 1920 totalled 9,932,910 marks, and the net profits 692,373 marks.

**Activities at Krupp's, Germany.**—The Germania shipbuilding plant of Krupp's at Kiel-gaardon is building passenger and freight steamers. At its various other establishments the company is manufacturing a great variety of work, including locomotives and railway supplies of all kinds, machines for the textile and paper industry, dredgers, floating docks, pneumatic tools, Diesel engines, etc. tions are doing this work and today the company is The same workmen who during the war made muniactually employing more men than before the war.

**Cargo Steamers, Nantes, France.**—The latest keel down at Nantes, where considerable activity in shipbuilding is very evident, is that of the cargo steamer Mellinet of 4,500 tons deadweight. The Chantiers de Bretague have just completed the cargo boat Cevennes, the last of seven sister ships ordered by M. M. Delmas Freres, of La Rochelle.

**Harbor to be Dredged, Malmo, Sweden.**—The free harbor at Malmo is to be dredged to a depth of 30 feet. The necessary financial support has already been agreed to, and it is hoped that the work will be completed by the first of July of next year. The work will be expedited as much as possible in order to have it ready for opening at the same time as the free harbor at Gothenburg.

**Swedish Tonnage Output.**—The "Swedish Export" states that the total tonnage of vessels launched in Sweden for the year 1920 was 42,000 tons gross. This figure is practically the same as for the previous year. Before the war the record figure reached was 22,000 tons in the year 1913.

**New Shipyard, Italy.**—A new shipyard has been constructed by the Italian Limited Company Ernesto Bread with a share capital L100,000,000 fully paid. The principal works and plants of the yard are now practically complete and production will soon begin. The site occupies an area of 130 acres and it is near the new harbor and industrial zone of Venice. The yard is equipped with the latest appliances with modern and powerful machines and vessels up to 950 in length can be laid down in the building berths.

**Shipbuilding and Repair Plant Wanted, Bahama Islands.**—According to a statement accredited to the Bahamas Development Board, there is an opening for the establishment of a shipbuilding and ship repairing plant at Nassau. The present ways are capable of accommodating small vessels only, but with the development of the port a dry dock or slipway to accommodate vessels of 1,000 tons or over will be necessary.

**Floating Dock, New South Wales.**—It is reported that the Commonwealth Government of Australia may build a floating dock of 55,000 tons capacity to improve its ship repairing facilities.

**British Shipbuilding Figures.**—The report of Lloyd's Register of Shipbuilding for the quarter ended June 30 shows a gross tonnage of 3,578,153 of new shipbuilding in the United Kingdom to date. From this a total of 1,179,000 tons, representing contracts suspended and postponed has to be deducted, leaving the net total building of 2,351,047 tons. Adding tonnage under construction in the Empire, the British total is 2,528,959 tons, or more by 37,450 tons than all the rest of the world together. The total includes 89 oil tankers of 585,980 gross tons. The total tonnage building in the United Kingdom is 268,000 tons less than at the end of the March quarter and 48,000 tons less than a year ago. The total tonnage launched during the second quarter of this year amounts to 321,690 tons, while the launching for the first quarter was 425,700 tons. The launchings represent only 2 per cent. of tonnage in hand.

**Baltic Reconditioned.**—Looking as fit as on the day she left Belfast on her first trials in 1904, the White Star liner Baltic has sailed from Messrs. Harland & Wolff's, after undergoing six months' reconditioning by the famous Queen's Island firm. During her stay in Belfast the Baltic has been entirely overhauled. The first-class accommodation has been improved by the provision of additional private bathrooms, while there have been numerous alterations in the accommodation with the object of bringing everything into line with the most modern requirements, and the public rooms have been redecorated. The machinery has also been thoroughly overhauled, and the ship is as good as new. The only White Star tonnage now in hand in Belfast is the Doric, which is on the berth in the North yard, but owing to prevailing conditions is not likely to be launched for some time.

**Nereus Launched.**—There was launched from the yard of the N. V. Ijselwerf, at Kampen, on June 22, the steamship Nereus, under construction for the Koninklijke Nederlandsche Stoomboot Maatschappij, of Amsterdam. The dimensions of the Nereus are: Length between perpendiculars, 226 ft.; breadth, 34 ft.; depth to the main deck, 15 ft. Triple expansion engines, developing about 600 I.h.p., and all the auxiliary machinery and winches are being supplied by the Machinefabriek Utrecht, of Utrecht.

**Steamer Building.**—The China Reederei A. G., in its report for 1920, states that it has a steamer of 3,200 tons gross, building at the Howaldtswerken at Kiel, for delivery early in 1922.

## LAUNCHINGS.

**Tilthorn.**—The steamer Tilthorn, built to the order of Messrs. Dampskibaktieselkapet, "Britannia," Bergen, was recently launched from the yard of William Doxford & Sons, Ltd., Sunderland, England. She is 420 feet in length, 54 feet breadth and 37 feet in depth, of the closed shelter deck type, and 10,800 tons capacity on 28¼ feet draft, with a speed of 12 knots. She was built under the supervision of Messrs. Arnesen, Christensen, & Smith, and Captain Larssen.

**Conde de Churruca.**—This new twin screw motor vessel, which was built to the order of the Sociedad Commercial de Oriente de San Sebastian by Sir W. G. Armstrong, Whitworth & Company, Ltd., England, was launched from the Walker shipyard last month. The vessel is of the twin-deck type with poop, bridge and forecastle, and has a raked stem and elliptical stern. She is 370 feet in length, 48 feet, 7 inches in breadth, 30 feet deep and is of 4,500 gross tons. Her propelling machinery consists of two sets of Armstrong-Sulzer Diesel engines, working on the two-cycle principle.

**Sierra Morena.**—The Burntisland Shipbuilding Company, Ltd., has launched the cargo steamer Sierra Morena, which was built for Danish owners. The vessel is of the single deck type, with a long bridge, and of 6,400 deadweight tons. She is 341 feet 6 inches long, 48 feet, 9 inches in breadth, and 27 feet, 3 inches in depth. She is built to comply with the highest classification of Lloyds.

**British Viscount.**—The British Viscount, which has been built and engined by Swan, Hunter & Wigham Richardson, Ltd., at their Neptune Engine Works, Newcastle-on-Tyne, sailed from the River Tyne on Monday, June 20. She is a large oil tank steamer, with all the latest improvements, built to the order of the British Tanker Co., Ltd., of London, being about 455 feet in length by 57 feet beam, and is designed to carry over 10,000 tons of oil. She has been constructed to attain the highest class in Lloyds Register, and is very fully equipped with the most modern and improved appliances for her service, including steam winches for working cargo and warping, installation of wireless telegraphy, Hele-Shaw steering gear, etc. The accommodation for the captain, officers, engineers and crew is of a very comfortable description, and there are a limited number of spare rooms. The propelling machinery consists of a set of double reduction geared turbines of the Metropolitan-Vickers Rateau type, supplied with steam by three large boilers fitted with Howden's forced draught. The auxiliary machinery in the engine room is driven electrically.

**Mont Viso.**—Steel screw steamer Mont Viso, built by Sir Raylton Dixon & Co., Ltd., at their Cleveland Dockyard, Middlesbrough, to the order of La Societe Generale de Transports Maritimes a Vapeur, Marseilles, has proceeded to sea for her official trials. The vessel has been built to a very complete specification and is of the two-deck type with bridge and poop combined and forecastle, her principal dimensions being 370′ x 53′ x 28′ 6″, moulded with a deadweight carrying capacity of about 7,800 tons on a light draft of water, and she has been constructed under special survey to receive Lloyds' highest classification, also to meet the requirements of French law, including fire extinguishing.

## SHIPBUILDING AND REPAIRING SITUATION.

The situation in the shipbuilding and repairing industry on the Clyde, Scotland, shows no improvement. Nearly all shipyards and marine engineering shops remain open, but many of them may as well be closed, for four days per fortnight is but a fraction of the working capacity of any engineering shop or shipyard, and it is only the desire to keep their works nominally open and their staffs together that many firms have not closed down before now. Yet behind all this depression, so far as work is concerned, there is a definite feeling of confidence in the future. It is believed that as soon as the costs of materials fall to a reasonable level and wages questions are settled, there are very good prospects of obtaining further contracts. Another difficulty with which they are confronted is the coal strike. Their stocks of coal are nearly exhausted, and although their orders are small they cannot obtain anything like satisfactory deliveries. Further the long strike of the shipyard joiners is helping to hold up work, and vessels are having to be sent to foreign yards to have their joinery work completed.

During the month of May there were only five cargo carrying vessels launched on the Clyde, three of which were over 1,000 tons each. The total tonnage of these five was 21,905 tons. There were 14 other small vessels launched of a total tonnage of 22,750 tons.

## IN THE NORTHEAST.

The situation on the North-east Coast may be shown by the following figures:

On the Tyne during May only four vessels were launched of a tonnage of 11,200 tons, as against 12 of 18,328 tons for the month of May, 1920. The total for the five months of this year is now 35 vessels of 102,966 tons, as compared with 38 vessels of 108,823 tons for the same period last year.

On the Wear during the month of May four vessels of 22,645 tons were launched, making 13 vessels of 61,427 tons for the five months of the present year, as compared with 134,018 tons for the corresponding period of last year.

There are about 170,000 adult workers unemployed on the North-east Coast, and approximately 26,500 adult workers on short time.

At the commencement of May there were no fewer than 226 vessels lying idle in the Tyne, the majority of them awaiting coal cargoes, and in May the total amount of coal shipped from the river as cargo was 109 tons, or 1,747 tons, including bunkers.

## IN SPAIN.

Shipbuilders in various parts of Spain are opposed to the plan of the Minister of Public Works de la Cierva for permitting the sale of vessels constructed in Spain under Government subsidy on condition that the builders return the subsidy. Several of the builders have visited the Minister, pointing out to him loopholes in the scheme which, they argue, favor certain shipbuilders and is not likely to solve the shipbuilding crisis. The Parliamentary Committee, which has the subject in charge, is taking the shipbuilders' objections into consideration and probably will change the plan, making it of wider scope.

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## BUSINESS NOTES

A. G. Briese, 30 Church Street, New York City, has been appointed Eastern sales agent by the Consolidated Shipbuilding Corporation for their speedway gasoline engines, medium and high duty. The Consolidated Shipbuilding Corporation, Morris Heights, N. Y., formerly the Gas Engine & Power, and Charles L. Seabury & Company, are the originators and manufacturers of speedway engines, and at the present time it is stated the facilities available will allow the manufacture of four times the usual output without attempting to manufacture the motors on a production basis.

The new building of the Western Electric Company, at 395 Hudson Street, New York City, was officially opened last month, several departments of the company having already moved into their new quarters. The building is an eleven-story structure, with a total floor space of 706,000 square feet. The company's New York shops and the great supply divisions of the eastern district territory, which include New York, New Jersey, Pennsylvania and the New England States, and the International Western Electric Company will move into the new building as their quarters are completed. Several new inventions will be used for the first time in this building. Mr. Walter Drury is the New York sales manager.

Mr. John D. Hurley, president of the Independent Pneumatic Tool Company, 600 West Jackson Boulevard, Chicago, Ill., sailed from New York City on the steamship *Olympic*, Saturday, July 16, for an extended trip throughout Continental Europe. Mr. Hurley was accompanied by Mrs. Hurley, his wife, and will make his trip one of combined business and pleasure. The Independent Pneumatic Tool Company are manufacturers of Thor Air and Electric Tools.

## TRADE PUBLICATIONS

Electrical Products.—Catalogue No. 23 illustrating and describing the products of the Benjamin Manufacturing Company, N. Y., has just been sent out. This catalogue lists such material as sockets, attachment plugs, reflectors and reflector fixtures, signals, portable lamps, panel boards, water and moisture proof fittings and marine panels and cabinets.

Fire Protection Systems.—The latest bulletin of the Grinnell Company, New York, contains articles outlining the use of Grinnell apparatus and sprinkler systems where low pressure water only is available; examples of the application of the systems to industrial plants through the South are also given.

Low Pressure Expansion Joint.—The general construction of low pressure expansion joints recently developed by the Griscom Russel Company, New York, is clearly illustrated and explained in a bulletin issued by the company. These joints are of the low pressure type especially adapted for use on steam lines between the turbine and condenser of a power unit.

Pneumatic Tool Accessories.—A booklet covering all the various accessories used in connection with air tool service has been sent out by the Ingersoll Rand Company, New York, makers of "Little David" pneumatic tools. The booklet describes air hose, hose couplings, hose clamps and menders, air drill chucks, rivet sets and blanks, wire brushes, grinding wheels, rail drilling equipment and the like. Convenient tables of dimensions of all rivet sets and chisels are given.

Renewable Fuses.—The Trico Manufacturing Company, Milwaukee, Wis., is distributing a number of small envelope folders devoted to the illustration and explanation of the Trico renewable cartridge fuses. The renewable element consists of a fuse length surrounded by an arc choking powder which kills any gases generated and prevents violent explosions.

Electric Hoists.—A new bulletin devoted to descriptions and applications of electric hoists to industrial purposes has been issued by the Electric Hoist Manufacturers' Association of New York. The pamphlet contains numerous photographs showing various types of electric hoists and hoisting apparatus in actual operation in plants having to handle a wide variety of materials.

Characteristics of Copperweld Wire.—A bulletin has recently been issued by the Copper Clad Steel Company, Rankin, Pa., which includes the loading tables and the characteristics of copperweld wire. These tables afford complete information as to the diameter, cross section, breaking load, allowable tension, load per lineal foot, elasticity and resistance of stranded, solid-bare, and solid weather proof copper clad wire.

Engineering Service Talks.—A number of folders are being distributed by Warren D. Spengler, Inc., Cleveland, Ohio, which give a series of electrical service talks. The first folder explains the advantage of periodical tests of equipment insulation, the second, drying electrical equipment to restore insulation value, and the third emphasizes the importance of analyzing power costs.

Alarm Systems.—A pamphlet sent out by the Holtzer Cabot Electric Company, Boston, Mass., describes some of the electric apparatus developed by the company as a result of its forty-five years' experience in this industry.

## MARINE SOCIETIES

### AMERICA

AMERICAN SOCIETY OF NAVAL ENGINEERS

Navy Department, Washington, D. C.
President—Capt. A. I. Hepburn, U. S. N.
Secretary-Treasurer—Commander J. S. Evans, U. S. N., Bureau of Engineering, Navy Department, Washington, D. C.
Annual meeting and election, first Tuesday in October, other meetings at call of the President.

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS

29 West 39th Street, New York.
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NATIONAL ASSOCIATION OF ENGINE AND BOAT MANUFACTURERS

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UNITED STATES NAVAL INSTITUTE

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National President—John H. Pruett, 423 Forty-ninth St., Brooklyn, N. Y.
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ATLANTIC COAST SHIPBUILDERS' ASSOCIATION

1701 Walnut Street, Philadelphia, Pa.
Secretary—C. S. King.

AMERICAN STEAMSHIP OWNERS' ASSOCIATION

17 Battery Place, New York
Vice-President and General Manager—Winthrop L. Marvin.

AMERICAN STEAMSHIP OPERATORS' ASSOCIATION

17 Battery Place, New York

### CANADA

GRAND COUNCIL, N. A. OF M. E. OF CANADA

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### GREAT BRITAIN

INSTITUTION OF NAVAL ARCHITECTS

5 Adelphi Terrace, London, W. C.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND

39 Elmbank Crescent, Glasgow.

NORTHEAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS

Bolbec Hall, Westgate Road, Newcastle-on-Tyne.

INSTITUTE OF MARINE ENGINEERS, INCORPORATED

The Minories, Tower Hill, London.

### ITALY

COLLEGIO DEGLI INGEGNERI NAVAL E MECCANICI IN ITALIA.

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